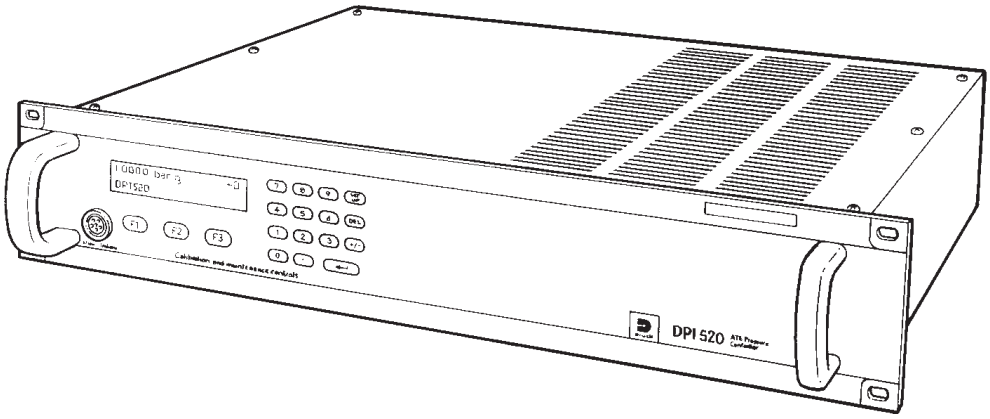
DPI 520

RACK MOUNTED PRESSURE CONTROLLER



DPI 520 Pressure Controller

Software Issue
This User Manual supports Software Issue No. 3.XX

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SAFETY

The Manufacturer has designed this product to be entirely safe when operated correctly.

- Please pay close attention to the Safety Instructions outlined on this page and elsewhere in this manual. They have been designed to protect the user from personal injury and the equipment from damage.

- Potentially hazardous operations are indicated in the text by means of a hazard warning triangle. Specific warnings relating to each section of the manual are given at the beginning of that section. On the instrument, this symbol indicates that the user should refer to the User Manual.

- Please observe the installation advice and any operational limits given in this manual.

- This equipment must only be used for the purpose for which it was designed

Pressure Safety

Do not permit pressures greater than the Safe Working Pressure to be applied to the instrument. The specified Safe Working Pressure for the instrument is stated in the Specification section of this manual.

Electrical Safety

The instrument is designed to be completely safe when used with Options and Accessories supplied by the manufacturer for use with the instrument.

Toxic Materials

During normal operation it is not possible for the user to come into contact with any hazardous substance which might be employed in the construction of the instrument. The use of hazardous materials in the construction of this instrument has been minimised.

Repair and Maintenance

This publication contains information and warnings which must be followed for safe operation and to maintain the equipment in a safe condition. Use qualified* personnel and good engineering practice for all procedures in this publication.
The operator must not use this equipment for any other purpose than that stated.

Do not apply a pressure greater than the maximum pressure stated.

* A qualified person must have attended a product training course given by the manufacturer or appointed agent and successfully completed the training course on this equipment.

CE

This product meets the essential protection requirements of the relevant EEC directives. Further details of applied standards may be found in the product specification.

ABBREVIATIONS

NOTE: Abbreviations are the same in the singular and plural.

ac	alternating current
atm	atmosphere
°C	degrees Celsius
°F	degrees Fahrenheit
COM	common
cm^2	centimetre squared
contd	continued
dc	direct current
DMM	digital multimeter
DUT	device under test
ENT	enter
FS	full-scale
ft	feet
kg	kilogram
LSD	Least significant digit
Pa	Pascal
PIN	personal identification number
mA	milli Amperes
mH_2O4	metres of water at 4°C
mm	milli metres
MSD	most significant digit
N/C	No Connection
No.	number
PRESS	pressure
PTX	pressure transmitter
RDG	reading
RS 232	serial data transmission standard
SCPI	Standard command for programmable instrumentation
T	tare
VAC	vacuum

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1 INTRODUCTION

Description

The DPI 520 is a programmable pneumatic pressure controller intended for applications in automatic pressure testing and calibration.

A rugged Druck piezo resistive transducer measures pressure and is compensated to standard or enhanced accuracy as required.

Dual loop control provides extremely accurate and repeatable setting of pressure output.

The Druck pneumatic control actuator achieves this level of control whilst also providing fast response and very low gas supply consumption.

Only 2U of 19 inch rack is required to house the unit which is controlled remotely by a host computer for fully automatic applications or from one of the range of Remote User Interfaces for manual or semi-automatic applications

Pressure demands via a digital interface are converted by the controller into a regulated pressure supplied from a line or bottle source. Both RS232 and IEEE 488 interfaces are provided as standard. The controller module has both control and measure modes. Up to three controllers may be ‘stacked’ and controlled from a single User Interface or computer.

Two levels of accuracy enhancement are available as Options A1 and A2. Option B provides negative pressure calibration.

The controller is interchangeable with a DPI 510 at IEEE and RS232 communications level. Essentially the DPI 520 is compatible with the Druck control software products InteCal and ACS.

A remote User Interface (RUI 100 and RUI 101) is available giving manual control and display on one, two or three DPI 520 in a 'stacked' system. In this way, control is provided to a high accuracy over a wide pressure range. *See the RUI 100/101 Product Note for details.*

1.1 Instrument Specification

Pressure Ranges

Output Pressure

..... 0 to 70 bar absolute
..... -1 to 70 bar gauge
maximum 2 bar line pressure on gauge units

Maximum Safe Working Pressure

.....125 % full scale pressure

Source Pressure Range

Positive pressure .....105 to 115 % full scale
Negative pressure ..... Lowest pressure used less 5%

Accuracies

Assuming regular zeroing of the instrument, the following figures apply.

Combined non-linearity, hysteresis and repeatability

Standard Instrument .....± 0.05% full scale
Option A1 ..... Refer to Options, Page 1-5
Option A2 ..... Refer to Options, Page 1-5

Temperature Coefficient

The temperature coefficient averaged over 10° to 30°C.
Standard Instrument ..... ± 0.01 % Reading/°C.
Options A1 and A2 ..... Refer to Options, Page 1-5

Stability

NOTE: The following figure indicates 90 day stability and assumes regular use of the zero facility.

.....± 0.015% of reading

Negative Pressures - Option B

Specification as per positive pressure but calculated as a percentage of the positive full scale.

Controller Performance

Controller Stability ..... ± 40 ppm of Full Scale
Fill Rate ..... Dependant upon system volume

Electrical Specification

Power Supplies

A.C. Supply Voltage ..... 88 to 264 V
Supply Frequency ..... 47 to 65 Hz
Power ..... 60 VA

Communications Interfaces

The controller provides two digital communications channels, an RS232 and an IEEE 488 channel. Three RS232 connections are provided but all of these access a single processor port.

Analogue Output

Type ..... Single ended D.C. voltage, representing controller output pressure, referenced to instrument ground.
Bandwidth ..... 2000 Hz to -6 dB
Ranges
Fixed, to order with full scale output in one of the following ranges:
..... 0 to 2V; 0 to 4V; 0 to 5V; 0 to 10V
Accuracy ..... ± 0.3% full scale
Temperature Error Band ..... ±0.5% F.S., 0° to 40°C.
Source Impedance ..... < 1000Ω

Input/Output Connections and Controls (Rear Panel)

Pneumatic Connections

Source, Vent and Outlet ..... G1/8 (female)
Reference ..... M5 (female)

Electrical Connections

Analogue Output ..... BNC connector - centre +ve, shell -ve

Host (RS232) ..... 9-pin, D-type connector, wired for point to point RS232 on pins 2 and 3

User Interface (RS232) ..... 9-pin, D-type connector for connection to Druck rack mounting Remote User Interface. Daisy chained to RS232 port. Supplies 24V D.C. supply for Remote User Interface.

IEEE 488 ..... Standard GPIB socket.

A.C. Power ..... IEC 320 connector. Line (L) and Neutral (N), individually fused within socket.

Electrical Controls

Stacking Switch..... Controls use of RS232 interface.

Calibration ..... Switch (located under calibration label), used only during instrument calibration.

Input/Output Connections (Front Panel)

Electrical Connections

User Interface (RS232) ..... 6-way Lemo socket for connection to Druck Desktop Remote User Interface, Type RUI 100. Daisy chained to RS232 port with automatic bypass when not in use. Supplies 24V d.c. for the user interface.

Environmental Specification

Temperature

Operating ..... 0° to +40°C
Operating (compensated) ..... +10° to +30°C
Storage ..... -20° to +60°C

Protection

Front panel .....to IP40

EMC

Meets: ..... EN 50081-1 (emissions)
..... EN 50082-1 (immunity)

Safety

Meets: ..... EN 61010-1

Pressure Media

.....clean, dry gas

Weight

..... 5.2 kg

Dimensions

..... 90 mm (high), 482 mm (wide) and 360 mm (deep)*

* Indicates case depth. Add 40 mm for the depth of handles.

Options

Option A1

Combined non-linearity, hysteresis and repeatability

.....±0.05% of reading (20% to 100% full scale)
.....±0.01% of full scale (0 to 20% full scale)

Temperature Coefficient

.....±0.002% rdg/°C (averaged over 10° to 30°C)

Option A2

Combined non-linearity, hysteresis and repeatability

.....±0.025% of reading (20% to 100% full scale)
.....±0.005% of full scale (0 to 20% full scale)

Temperature Coefficient

.....±0.002% rdg/°C (averaged over 10° to 30°C)

Option B

Negative Calibration

Error as a percentage of +ve full scale. Value depending on the accuracy option chosen.

Accessories

The instrument is despatched with the following items:

User Manual (K163)
Calibration Certificates
Power Supply Lead

1.2 APPLICATIONS

1.2.1 Control by Remote Computer via IEEE 488

Using the IEEE 488 general purpose control bus, a remote computer can control either a single stand alone unit or a number of units up to a maximum of 15. When controlling a number of instruments each instrument on the bus is allocated a unique address (set with the instrument via a SETUP facility). Each instrument is first addressed and then instructed by means of control codes to carry out the required functions (e.g.) mode change, output pressure change, rate change or send current output pressure.

A special application of this mode of control allows the output pressure ports of a number of controllers to be connected together into a common manifold. By using instruments with different control pressure ranges, this permits a wide range of accurately controlled pressures to be applied to a common manifold.

Figure 1.1 shows the general arrangement. Section 3 contains details for the installation of this configuration of instruments.

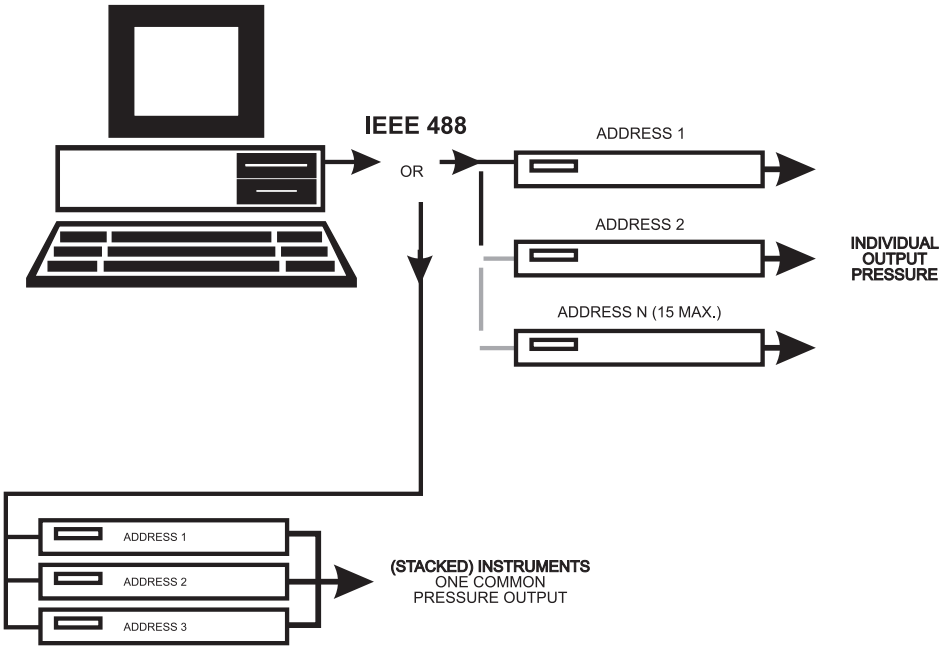


Figure 1.1 - Control by Remote Computer via IEEE 488

1.2.2 Control by Remote Computer via RS232

- **PC to Instrument**

  A single instrument is connected directly to a computer and communications can be controlled either by full hardware handshaking or software handshaking. Section 3, Installation, details the connection method for both options.

- **Instrument to Printer**

  A stand alone instrument can be connected to a non-intelligent terminal or a printer. In this mode the instrument provides a continuous flow of data, on a timed basis. Interconnection details are the same as for the connection of a control computer and are given in Section 3.

1.2.3 Control via Remote User Interface

Two types of Druck Remote User Interface can be used to control up to three DPI 520 instruments. These remote interface units, types RUI 100 (desk top) and RUI 101 (rack mounted), plug into special user interface sockets, located on the front and rear panels respectively.

The Remote User Interface is automatically powered as soon as it is plugged into a controller.

The RUI assumes that the controllers have a common pressure output. Using instruments with different pressure ranges permits a wide range of accurately controlled pressures to be applied to a single outlet.

Figure 1.2 shows the general arrangement. Refer to K181 for details of RUI 100/ 101 connections.

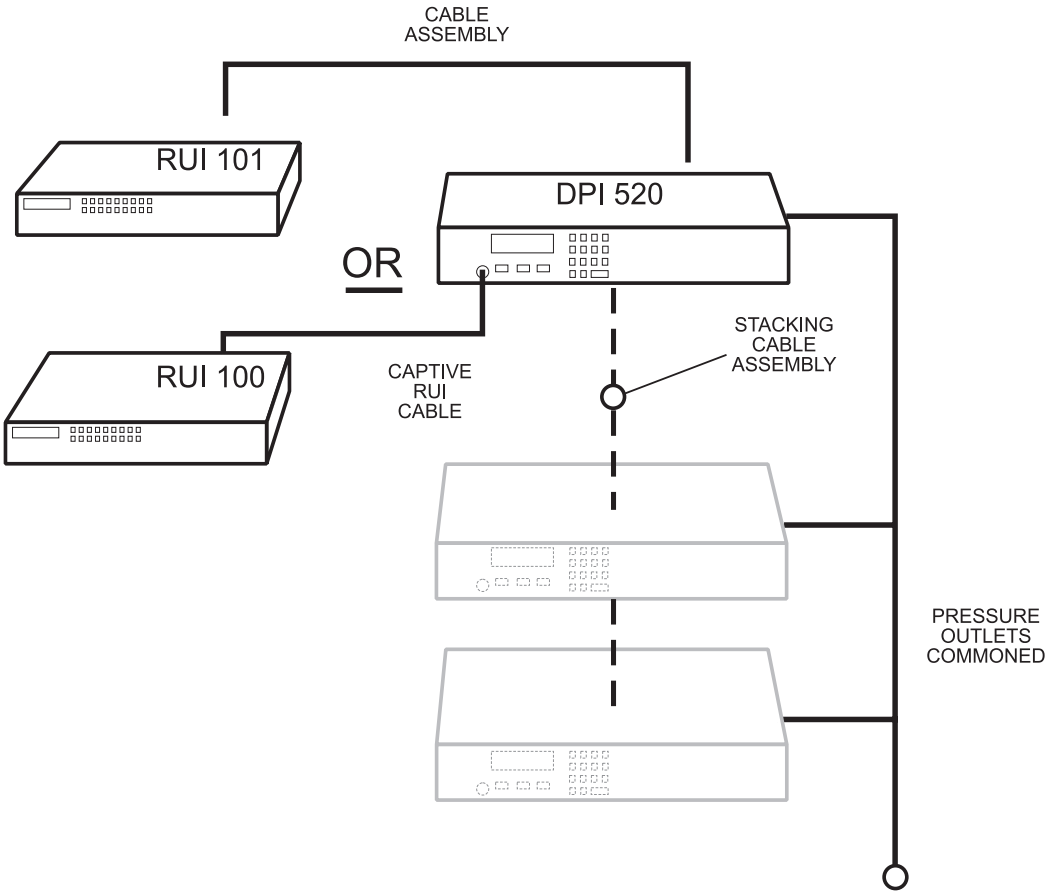


Figure 1.2 - Control from a Remote User Interface

2 FUNCTIONAL DESCRIPTION

2.1 General

The DPI 520 instrument is a single channel pressure controller, designed to be programmed either from an external computer system or remote user interface. No user controls are provided on the instrument, it's local keyboard being used only for set-up, calibration and maintenance operations. The use of these functions are described in Sections 4 and 5 respectively.

Digital programming of the instrument is effected via a RS232 serial interface or via an IEEE 488 parallel interface. The instrument can be configured in a number of different ways as detailed in Section 1. Section 3 details the installation procedures.

2.2 Instrument Electronics

2.2.1 Digital Electronics (Fig 2.1)

The instrument draws it's power supplies from an internal power supply unit which is, in turn, powered from an external a.c. source.

An internal microprocessor system controls the RS232 and IEEE 488 communications channels. One RS232 port is provided and one IEEE 488 channel. The RS232 port has three inputs, one of which is used for host communications. The other two are used for the connection of either the Druck RUI 101 (rack mounted) or the RUI 100 (desktop) Remote User Interfaces.

Although there are three RS232 connectors on each instrument, (one RS232 and two User Interfaces), effectively they access only a single RS232 processor port. A switching network has auto detection of the presence of a Remote User Interface (RUI), plugged into one or other of the RUI sockets.

The microprocessor system also controls the flow of data to the instrument's display. The display is a two line (20 characters/line) liquid crystal dot matrix type. Operationally, it is used to display pressures, functions and messages.

A keyboard, linked to the microprocessor, provides a user interface for set-up and calibration purposes only. It is not used for normal operation, all operational commands being sent via one of the two communications interfaces.

Control of the Analogue to Digital (A-D) Converters used in the analogue and valve control circuits is effected via the microprocessor system's bi- directional control bus. A simplified description of the analogue control channel follows.

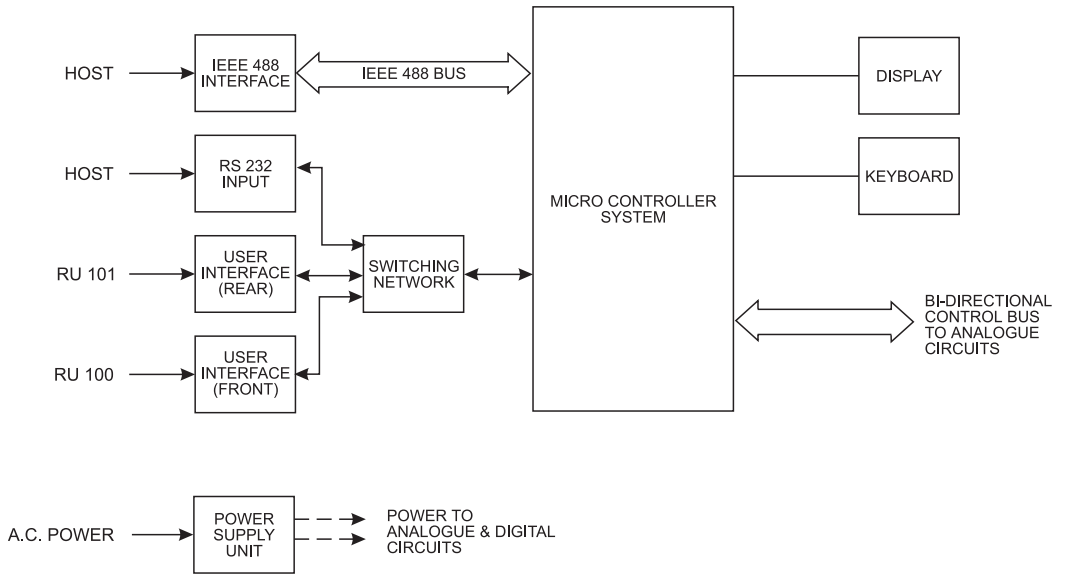


Figure 2.1 - Digital Electronics, Functional diagram

2.2.2 Analogue Circuit Operation (Fig 2.2)

Output pressure control is effected by means two solenoid operated valves. One of these valves, the **Apply** valve, controls the application of a source pressure to the output manifold. The other valve, the **Release** valve, releases the output pressure. The output pressure is controlled by modulating the drive to each of these valves, controlling their relative on/off times. An **Isolation** valve, also controlled by the microprocessor, is used to isolate the controller from the external pneumatic system. The controller output pressure (external system pressure when the isolation valve is open), is measured by a suitably scaled, internally mounted, pressure transducer.

Pressure demands to the controller are sent via either the RS232 or IEEE 488 communications interface and decoded by the microprocessor. The decoded demand is sent to the setpoint A-D converter, processed (with other loop control terms) and applied to an error amplifier. The other input to the error amplifier is the transducer output signal, (representing the actual pressure at the controller output).

The error amplifier produces a bipolar error signal proportional to the magnitude and direction of the error between the setpoint demand and the actual output of the controller. This error is first processed by an error signal processing circuit, under the control of the microprocessor, to drive a pulse width modulator. The output of the pulse width modulator drives the **Apply** and **Release** valves to change the output pressure in an appropriate direction to correct the error i.e. to equalise the setpoint demand and pressure feedback signals. A temperature feedback signal from the output manifold, modifies the drive to the output valves should they become overheated.

An analogue signal, proportional to the output pressure, is derived from the output of the pressure sensing transducer. The output of the pressure transducer is scaled by an amplifier/buffer and filtered before outputting from the instrument as a d.c. signal. The gain of the output amplifier is set during manufacture to provide one of four scaled ranges (refer to Section 1 - Specification).

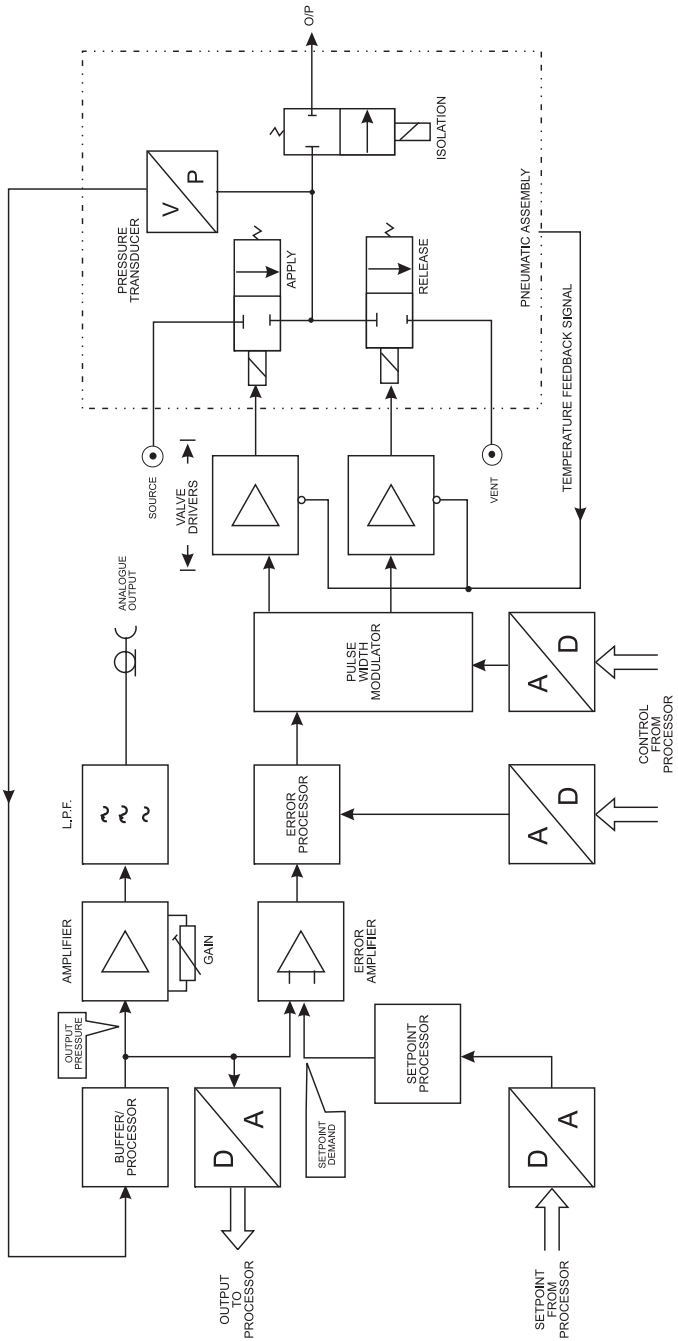


Figure 2.2 - Analogue Electronics, Functional Diagram

3 INSTALLATION

3.1 Safety Instruction

IT IS ESSENTIAL THAT THE INSTALLATION OF ELECTRICAL AND PNEUMATIC SUPPLIES BE UNDERTAKEN BY A COMPETENT PERSON.

INSTALLATION REQUIREMENTS

1. **THE INSTRUMENT IS DESIGNED TO BE RACK MOUNTED IN A STANDARD 19" RACK OR SUB-RACK AND OCCUPIES 2U OF SPACE.**

2. **PROVISION MUST BE MADE FOR A FLOW OF AIR THROUGH THE VENTILATION SLOTS ABOVE AND BELOW THE INSTRUMENT.**

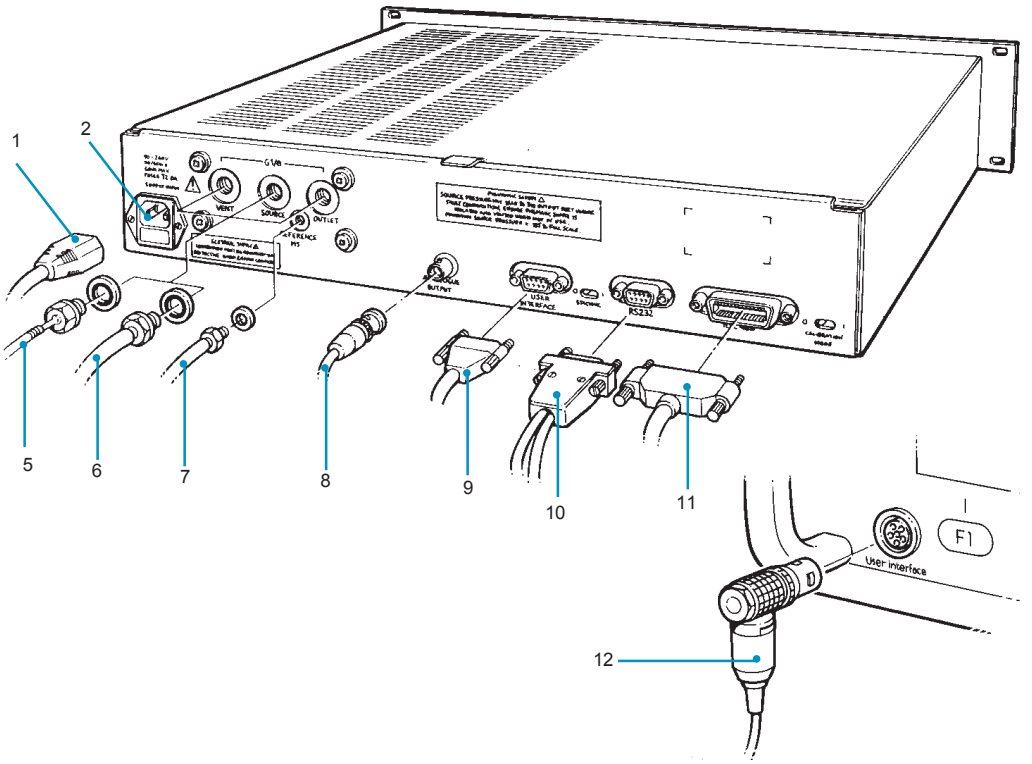
3.1.1 Input/Output Connections (Fig. 3.1 and 3.2)

All connections to the instrument, with the exception of an alternative Remote User Interface connection, located on the front panel, are made to the rear panel of the instrument. Fig 3.1 shows a diagram of a typical rear panel layout, together with the electrical and pressure connections.

3.1.2 Rack mounting

To install the instrument in a standard 19" rack, proceed as follows:

- If the instrument has been previously installed, isolate and disconnect all power supplies.
- Isolate all pressure supplies and disconnect all pressure inlet and outlet connections.
- Remove any electrical connectors connected to the instrument (e.g.) RS232 and IEEE 488 connectors.
- Before installing, make sure that there is enough length of cable and pipe for the installation and removal of the instrument.
- Connections are made at the rear of the instrument, allow enough space for the cables and the pipes when the instrument is pushed back and secured in the rack. It is important to allow cooling air to flow through the instrument.



Key to figures 3.1 and 3.2

1	IEC connector	2	IEC power supply socket assembly
3	fuse holder	4	fuse
5	small bore connector (G1/8)	6	large bore connector (G1/8)
7	reference connector (M5)	8	analogue output connector
9	user interface connector (rear panel)	10	RS232 interface connector
11	IEEE 488 interface connector	12	user interface connector (front panel)

Figure 3.1 - DPI 520 Rear Panel Connections

3.2 Electrical Connections

3.2.1 Electrical Safety Instructions

IT IS IMPORTANT TO USE THE CORRECT SUPPLY SETTINGS. OPERATING VOLTAGE RANGES ARE MARKED ON THE REAR PANEL OF THE INSTRUMENT AND ARE GIVEN IN SECTION 1, SPECIFICATION.

It is essential that the Earth lead (coloured green/yellow) is connected to the a.c. Supply Protective Safety Earth.

Before making any electrical connections to the rear panel, isolate the incoming power supply.

Before removing any covers, isolate the instrument from all its supplies.

3.2.2 Power Supply Connections (Fig. 3.1 and 3.2)

The instrument is powered from a.c. mains. Section 1, Specification, gives full details of the power supply requirements.

- **A.C. Power Supply**

  The a.c. power supply socket assembly (2) is located on the rear panel as shown on Fig 3.1. A fuse (4) is also contained within the power supply socket assembly (2), details of the fuse fitting being shown in Fig 3.2.

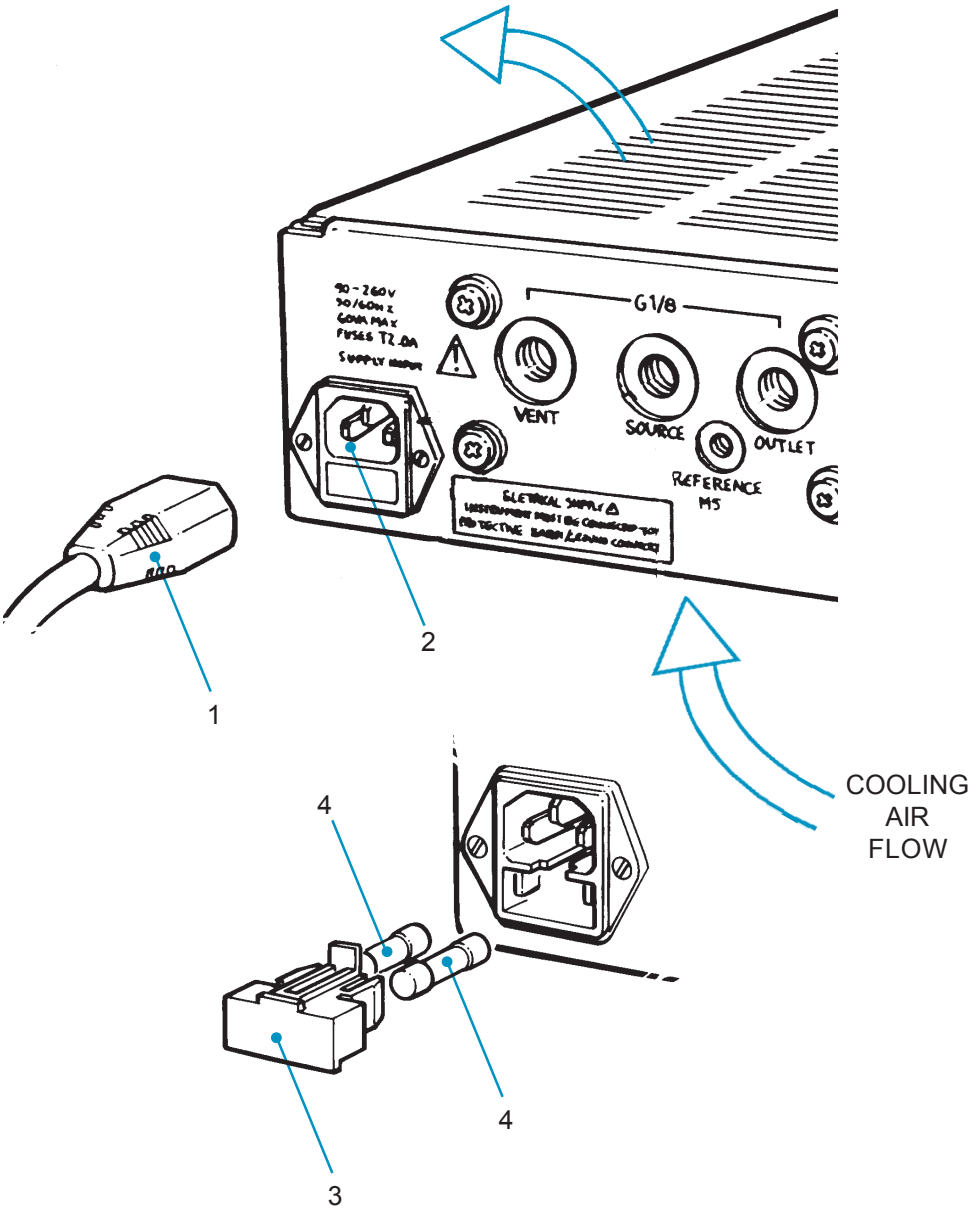


Fig 3.2 A.C Power Supply Socket

To connect the a.c. power supply, proceed as follows.

- Insert the moulded IEC connector (1) into the power supply socket assembly (2) and connect to a suitable a.c. power source. Refer to Section 1, Specification for power supply details.
- Switch on the a.c. power source.
- Check that the display is on.
- If the instrument display does not come on, isolate the external power supply and remove the IEC connector (1) from the power supply socket assembly (2).
- Remove the fuse carrier (3) as shown in Fig 3.2, insert one or two new fuses (4) as required and refit the fuse carrier. Fuses are Type T2A, rated at 250V, 2 Amps.
- Reconnect the IEC connector (1) and switch on the power supply and the instrument. The display should now come on.
- Switch off the power supply to the instrument.

3.3 Communications Interface Connections (Fig. 3.1 and 3.2)

Both the RS232 and IEEE 488 interfaces, through one or other of which the instrument is controlled, are connected by polarised connector plugs (10 and 11). To connect up the interfaces, fit the appropriate connectors into the relevant sockets and tighten up the securing screws. The following sections describe the connection to an external controller and the interconnection of the communications channel between a number of instruments.

3.4 IEEE 488 Interface (Fig. 3.3)

The IEEE 488 General Purpose Interface Bus (GPIB), is a parallel interface used to connect a host computer/controller to one or more DPI 520 instruments and possibly other instruments. A typical system is shown in Figure 3.3. To connect a number of instruments together, the IEEE 488 bus is connected, in parallel, to all devices on the bus.

The bus lines basically divide into three groups, Transfer Control Lines, Management Lines and a bidirectional address/status bus. The pin out of the connector is shown in Figure 3.3.

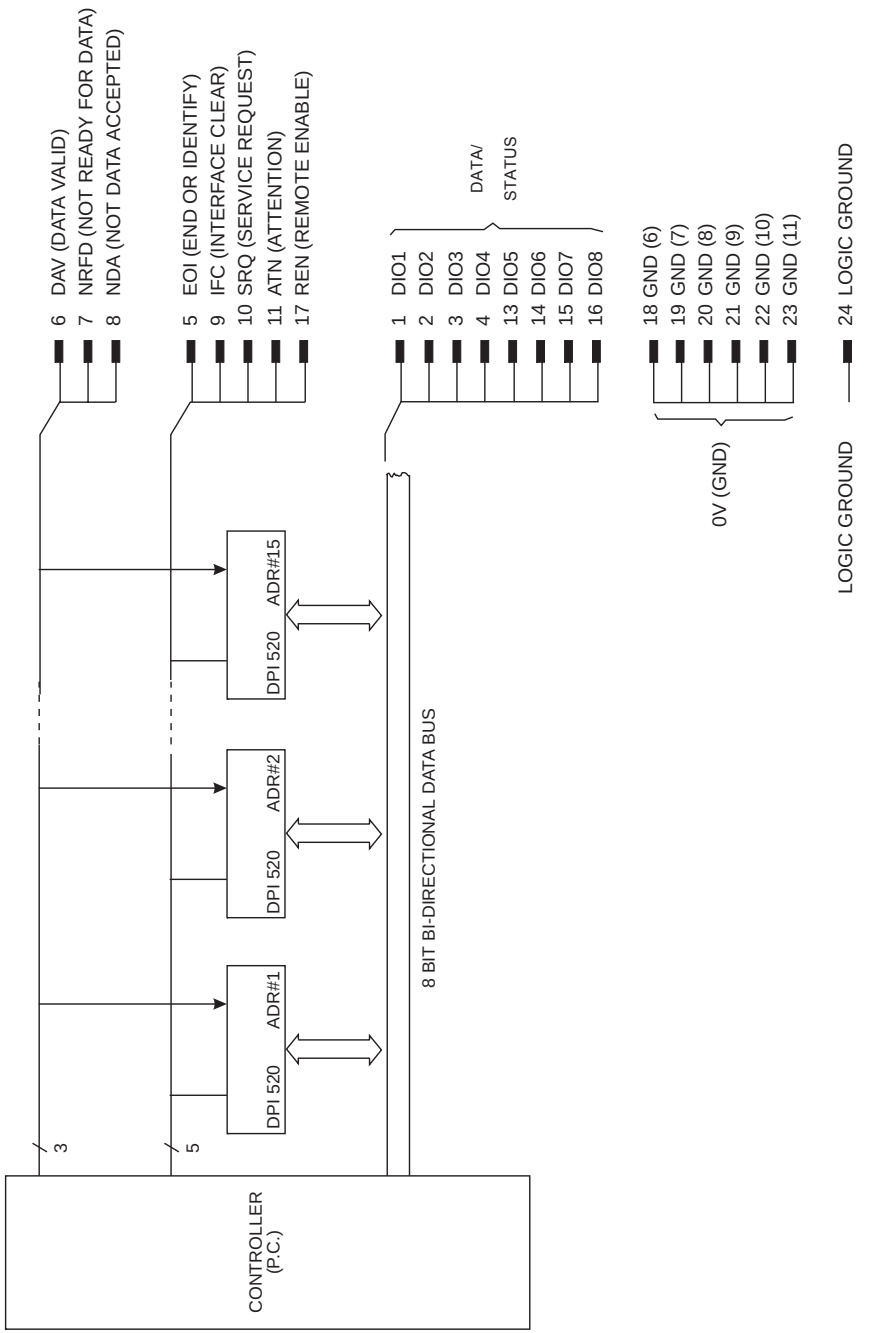


Fig 3.3 - IEEE 488 Connection

Separate ground connections are provided for each of the Transfer Control Lines and the IFC and SRQ lines, all of which are run as twisted pairs in the IEEE 488 cable.

CAUTION: For EMC compliance, all leads must be less than 3M in length.

To connect up the IEEE 488 interface, proceed as follows.

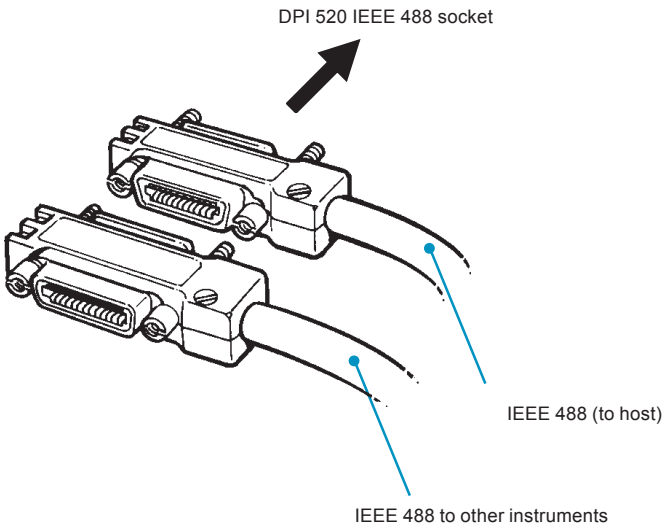
3.4.1 Single Unit Installation (Fig 3.1)

- Plug an IEEE 488 connector/cable assembly (11), into the IEEE 488 socket located on the rear panel of the instrument.
- Connect the other end of the connector/cable assembly into the IEEE 488 socket on the host system.
- Change the IEEE communication parameters as described in the **Setup Menu** (refer to Section 3.9.3).

3.4.2. Multiple Unit Installation

In order to extend the IEEE 488 bus to a number of different units, stacking plugs are used to link down from one instrument to the next. Proceed as follows.

- Plug a pair of IEEE 488 stacking connectors as shown below, into the IEEE 488 socket located on the rear panel of the instrument.



- Connect the other end of one of the connectors into the IEEE 488 socket on the host system and the free connector into the next unit in line.
- Continue to loop down, stacking two plugs into each unit until the required number of units have been connected to the bus.

CAUTION : Whilst with the use of stacking plugs it is, if required, possible to stack more than two plugs into a single socket, care should be taken to ensure that undue strain is not placed on an instrument socket by stacking in too many plugs.

- Use the **Setup (Comms)** menu on each instrument to set up the required communication parameters (Refer to Section 3.9.3).

3.5 RS232 Interface

3.5.1 General

The RS232 communications system enables a control computer (host) or a Remote User Interface (RUI) to control a single instrument or number of interconnected instruments by sending and receiving data over a serial interface.

There are three RS232 connectors located on each instrument, two on the rear panel and one on the front panel. Effectively, all three connectors access only a single RS232 port on the instrument, (Refer to Section 2.2.1). Two 9-pin D-type connectors are located on the rear panel and a third, a 6-pin Lemo connector is located on the front panel. One of the rear panel connectors and the front panel connector are dedicated to the connection of a Druck Remote User Interface (RUI 101- rear, RUI 100 - front). The remaining 9-pin D-type connector is for connection of a host computer and the daisy-chain system.

In addition to carrying the standard RS232 signals, the two RUI connectors supply power (24V d.c.) to the Remote User Interface. Table 3.1 shows the signal allocations to each connector and the cross relationship to the standard RS232 system. The instrument is configured as Data Control Equipment (DCE).

Instrument			Control Line		Computer/Printer	
Instrument Function	Connector Type		Signal Direction	RS232 Terminology	Connector Type	
	Lemo Conn. pin no.	9-way D-type pin no.			9-way D-type pin no.	25-way D-type pin no.
RxD(I/P)	1	3	←	TxD	3	2
TxD(O/P)	6	2	→	RxD	2	3
GND	3	5	↔	GND	5	7
CTS(I/P)	2	7	←	RTS	7	4
RTS (O/P)	5	8	→	CTS	8	5
Pulled high internally	4	1	→	RLSD (DCD)	1	8
Not Used	N/C	4	←	DTR	4	20
Pulled high internally	4	6	→	DCR DCE Ready	6	6
Equipment Chassis	Connector Shell	Connector Shell	↔	Cable Screen	-	1

* Note 1 - Pin 9 used for RxD in daisy chain network applications only

Table 3.1 - RS232 Connections

Section 3.5.2 details the method of connecting the RS232 interface.

3.5.2 Connecting to a Computer

The connection method for RS232 operation between a host computer and the instrument depends on the handshaking method to be implemented and the type of connector used on the computer's output port. Table 3.1 shows the connections and the following schematic diagrams detail the correct wiring information.

Connections to the instrument should be made to the 9-pin, D-type connector labelled **RS232** and the switch labelled **STACKING**, located on the rear panel should be set to the **O** position as shown below.

Two methods of setting up the computer connections are provided. Refer to section 3.6.3 and figure 3.14 for RS232 set up details.

Software Handshaking

Computer with 9-pin D-type Connector

For software handshaking between the instrument and a host computer (or printer) that uses a 9-pin, D-type port connection, proceed as follows.

- Connect pins 6, 4 and 9 together and link pins 7 and 8 at the host connector end of the cable.

- Connect the host comms port to the DPI 520 instrument's 9-way, D-type, **RS232** port connector as shown in Figure 3.4.

- Use the setup (comms) menu (see Section 3.6.3), to set up the required RS232 parameters. $\mathbf{X_{ON}/X_{OFF}}$ should be set to ***Enabled***.

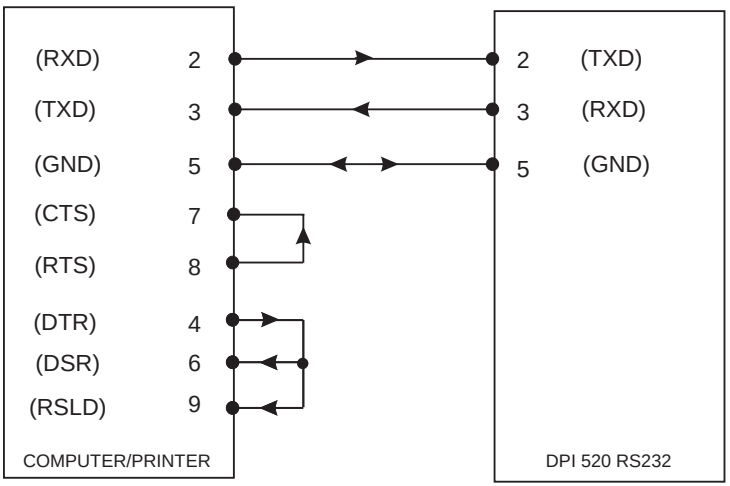


Figure 3.4 - RS232 9-Way Connections (Software Handshaking)

Computer with 25-pin D-type Connector

For software handshaking between the instrument and a host computer that uses a 25-pin, D-type port connector, proceed as follows.

- Connect pins 6, 8 and 20 together and link pins 4 and 5 at the host connector end of the cable.
- Connect the host computer communications port to the DPI 520 instrument's 9-way, D-type, **RS232** port connector as shown in Figure 3.4.
- Use the setup (comms) menu (see Section 3.6.3) to set up the required RS232 parameters. $\mathbf{X_{ON}}/\mathbf{X_{OFF}}$ should be set to **Enabled**.

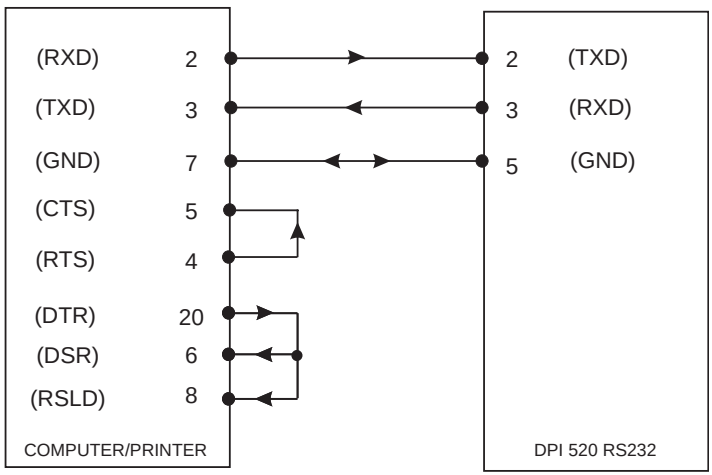


Figure 3.5 - RS232, 25-way Connections (Software Handshaking)

Hardware Handshaking

Computer with 9-pin D-type Connector

For hardware handshaking between the instrument and a host computer that uses a 9-pin, D-type connector, proceed as follows.

- Connect the host communications port to the DPI 520 instrument's 9-way, D-type, **RS232** connector as shown in Figure 3.6.

- Use the setup (comms) menu (see Section 3.6.3), to set up the required RS232 parameters.

NOTE: *Some computer installations do demand hardware handshaking. Its use is not recommended unless so demanded. The additional wiring and logic operations may cause problems.*

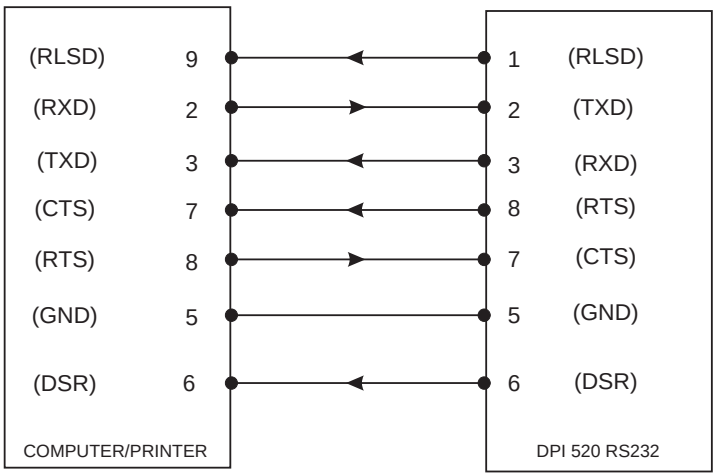


Figure 3.6 - RS232 9-way Connections (Hardware Handshaking)

Computer with 25 Pin D-type Connector

For hardware handshaking between the instrument and a host computer that uses a 25-pin, D-type port connection, proceed as follows.

- Connect the host communications port to the DPI 520 instrument's 9-way, D-type, **RS232** port connector as shown in Figure 3.7.

- Use the setup (comms) menu (see Section 3.6.3), to set up the required RS232 parameters.

- If data transfer problems are experienced with this configuration, it may be necessary to use a null modem connector. This effectively means reversing the connection to pins 2 and 3 at the host computer end of the cable.

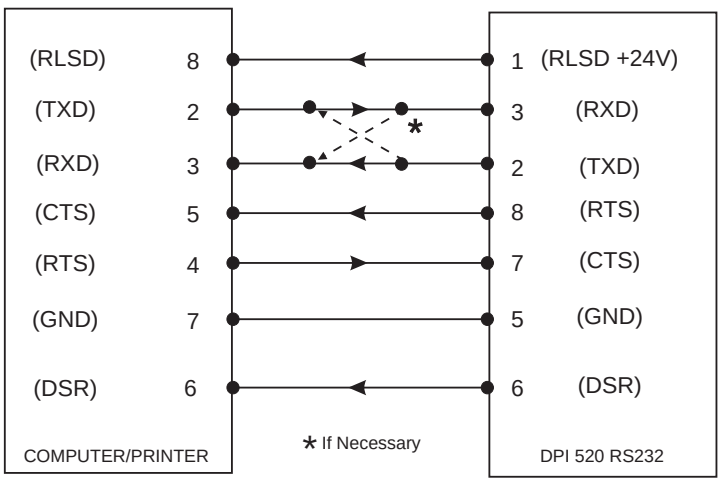


Figure 3.7 - RS232, 25-Way Connections (Hardware Handshaking)

No Handshaking

Computer with 9-pin D-type Connector

For applications where no handshaking is required between the instrument and a host computer (or printer) that uses a 9-pin, D-type port connection, proceed as follows.

- Connect pins 6, 4 and 9 together and link pins 7 and 8 at the host connector end of the cable.

- Connect the host comms port to the DPI 520 instrument's 9-way, D-type, **RS232** port connector as shown in Figure 3.4.

- Use the setup (comms) menu (see Section 3.6.3), to set up the required RS232 parameters. $\mathbf{X_{ON}/X_{OFF}}$ should be set to ***Disabled***.

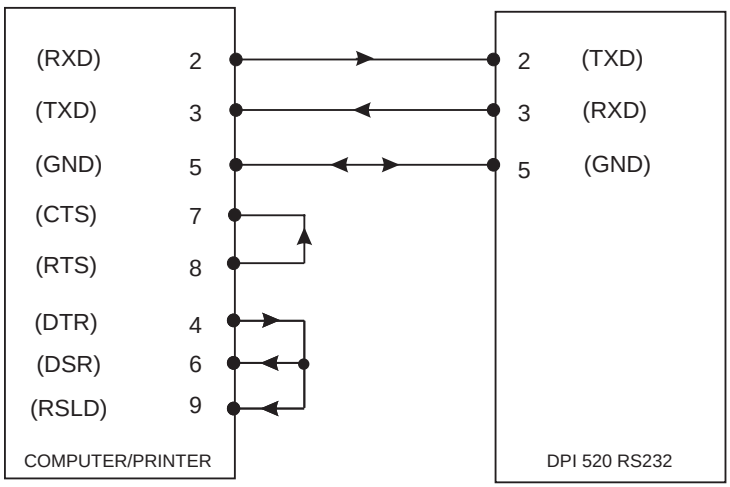


Figure 3.4 - RS232 9-Way Connections (Software Handshaking)

Computer with 25-pin D-type Connector

For applications where no handshaking is required between the instrument and a host computer (or printer) that uses a 25-pin, D-type port connector, proceed as follows.

- Connect pins 6, 8 and 20 together and link pins 4 and 5 at the host connector end of the cable.
- Connect the host computer communications port to the DPI 520 instrument's 9-way, D-type, **RS232** port connector as shown in Figure 3.4.
- Use the setup (comms) menu (see Section 3.6.3) to set up the required RS232 parameters. $\mathbf{X_{ON}}/\mathbf{X_{OFF}}$ should be set to ***Disabled.***

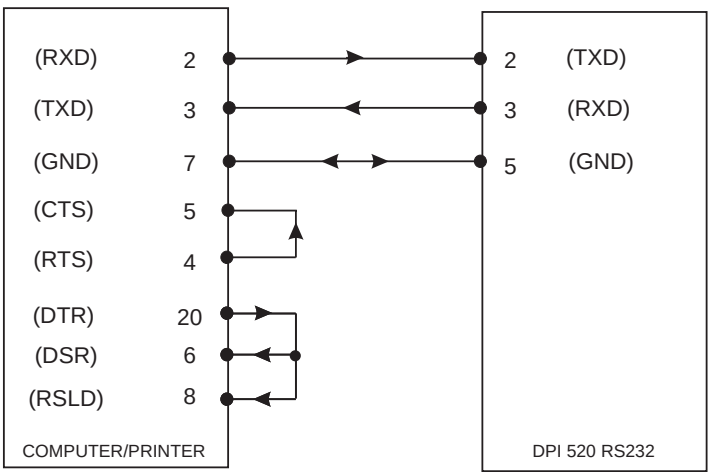


Figure 3.5 - RS232, 25-way Connections (Software Handshaking)

3.6 Connection of Remote User Interface

Refer to publication K181 for connection details.

3.7 Analogue Output Socket

Connection to the **Analogue Output** socket is made via a coaxial BNC connectors. To connect to the sockets, connect a lead fitted with a BNC plug to the socket and turn clockwise to lock the bayonet into place.

The pin out the socket is shown in Fig 3.8.

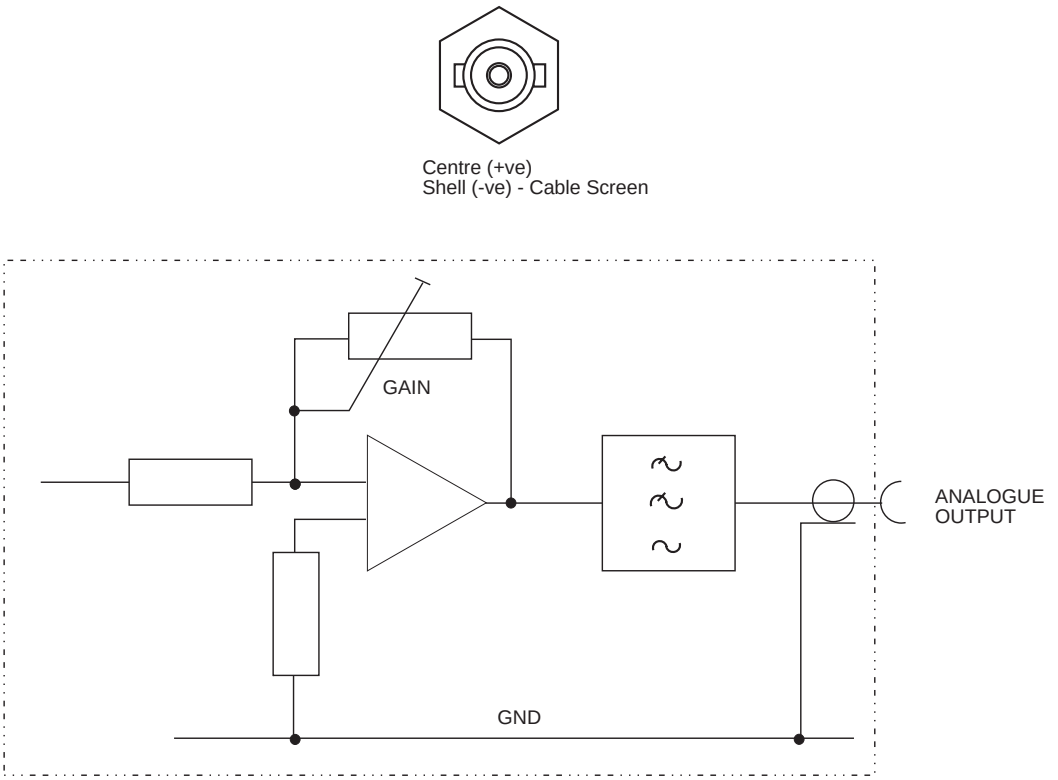


Fig 3.8 - Analogue Output Socket Connections

3.8 Pressure Connections

3.8.1 Pressure Safety Instructions

ALWAYS CHECK FOR TRAPPED PRESSURE BEFORE CONNECTION OR DISCONNECTION OF PRESSURE COUPLINGS.

ENSURE THAT CORRECTLY RATED PIPES AND FITTINGS ARE USED.

OBSERVE MAXIMUM WORKING PRESSURE OF THE INSTRUMENT.

3.8.2 Connection (Fig. 3.9 and 3.10)

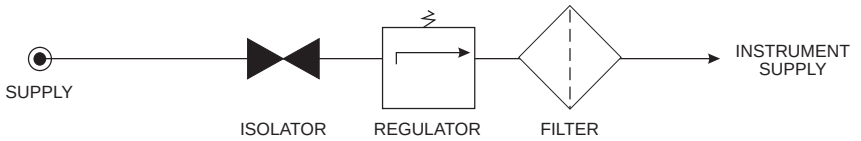
To connect up to a pneumatic port, proceed as follows. Make sure that there is enough length of cable and pipe for the installation and removal of the instrument, Figure 3.9 shows the method of fitting. The instrument may need to be removed regularly from the rack for calibration. Alternatively a pressure standard can be connected to the instrument when fitted in the rack.

Source Pressure Port

SOURCE PRESSURE CAN LEAK TO THE OUTLET PORT UNDER FAULT CONDITIONS, EVEN WITH ELECTRICAL POWER REMOVED. MAKE SURE THAT THE USER SYSTEMS CAN BE ISOLATED AND VENTED.

For a given instrument, the **Source** pressure must be in the specified source pressure range, see Section 1.1. When connecting a number of instruments of differing ranges to a common **Source** pressure, to ensure that the source pressure for each instrument does not exceed the maximum level for that instrument and to obtain the specified control performance, appropriate external pressure regulators must be provided (refer to Fig. 3.10).

- Ensure that the source pressure supply is isolated from the supply line. It is recommended that a 40 micron filter, regulator and an isolation valve be fitted between the pressure source and the instrument as follows (e.g.).



The instrument does have filters fitted internally but only to protect against ingress of large particles, see section 6.3 for cleaning. Using an additional external filter prevents the internal filters from becoming blocked.

- Fit the source pressure supply line to the **Source** connection port as shown in Fig. 3.9, fitting a bonded seal between the pressure union and the measuring port. Note the **Source** port has a $G^1/_8$ thread. Ensure that the coupling is tight.

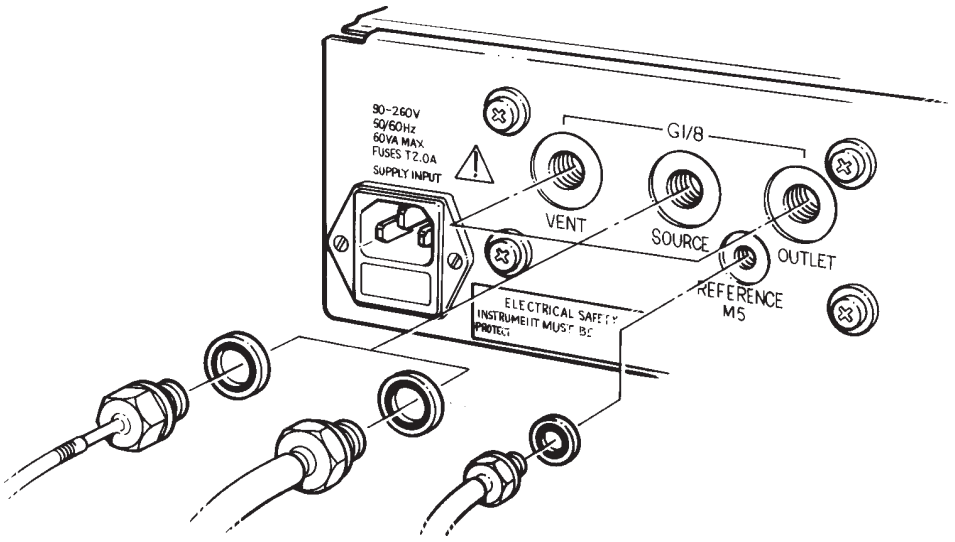


Fig 3.9 - Pneumatic Connections

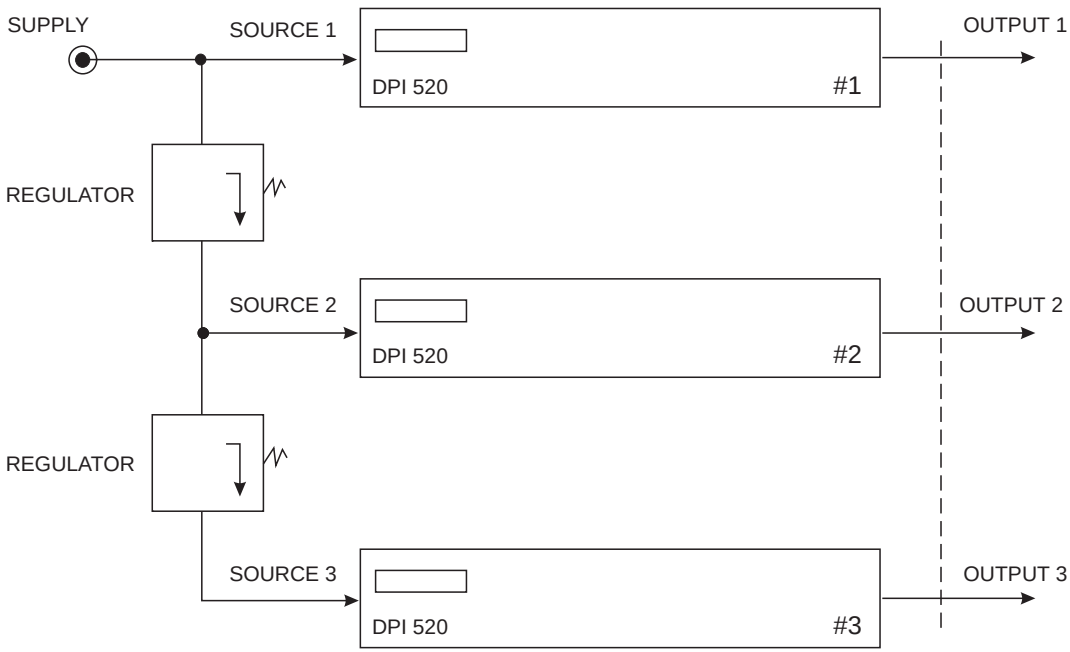


Fig 3.10 - Source/Output Connection Schematic

Output Pressure Port (Fig 3.10)

Depending on the application, the **Output** ports of instruments with differing full scale outputs can be either be connected separately or connected together (in parallel). When connected in parallel, only one instrument can be used at a time and the lower ranges must have their isolation valves closed to avoid damage. The connection method is as follows.

- Ensure that the external system is at zero pressure.
- Fit the output pressure line to the **Output** connection port as shown in Figure 3.9, fitting a bonded seal between the pressure union and the measuring port. Note that the output port has a $G^1/_8$ thread fitting. Ensure that the coupling is tight.

Vent Port

When the controller reduces the outlet pressure, gas flows from the user's system out of the **Vent** port of the controller. Initially, this port can be at the full working pressure of the system. Any equipment connected to the vent port (e.g.) pipes, fittings and vacuum pump, must be capable of handling the flow/pressure safely. Refer to specification for details of vent pressure range.

❍ Positive Gauge Pressure Control

Where only positive pressure is to be controlled, then the vent port simply needs to be able to discharge system pressure to atmosphere. Care needs to be taken because the initial discharge pressure is the outlet pressure. On high pressure ranges, acoustic noise will be produced when a fast rate is selected on the controller. If the rear of the instrument is protected from direct access by personnel, then no fittings need be used and the vent port discharges directly to atmosphere. Where personnel access is possible, the vented gas should be piped away to a safe area. For gauge instruments, connection of a vacuum supply will assist in the controlling of low pressures around zero.

Fit the vent line to the **Vent** port as shown in Fig. 3.9, fitting a bonded seal between the pressure union and the measuring port. Note that the **Vent** port uses a $G^1/_8$ thread fitting. Ensure that the coupling is tight.

❍ Negative Gauge and absolute

For negative gauge pressure applications, a vacuum pump should be connected to the **Vent** port. The pump should be rated for the desired low pressure and have suitable flow capability. Care should be taken to avoid oil contamination from the pump from entering the controller. It is good practise to fit a solenoid valve, energised from the pump's electrical supply such that the vacuum is automatically released when the supply is interrupted. Refer to specification for details of vent pressure range.

Reference Port

The reference port is used on gauge instruments. It is the port which supplies pressure to the reverse side of the measuring transducer. Normally, this is atmospheric pressure. Ambient pressures acting on the reference port of low pressure instruments can have significant effects on the pressure reading. A restrictor screwed into the port can reduce display noise on low pressure instruments. To connect the reference line, proceed as follows.

CAUTION: The REFERENCE port pressure must NOT exceed two times the full scale pressure range or 2 bar whichever is the smaller or the internal pipes and integral transducer could be damaged.

- Fit the reference line to the **Reference** port as shown in Fig. 3.9, fitting a bonded seal between the pressure union and the measuring port. Note that reference port has an **M5** thread fitting. Ensure that the coupling is tight.

3.8.3 Obtaining the Best Performance

Optimum Source and Vent Pressures

The instrument pressure controller can only supply pressures that are within the range of the source and vent supplies and will only control to specification within 5% of the supply pressures.

The recommended source pressure is 110% of the range selected (e.g.) 77 bar on a 70 bar range). The vent pressure should be 5% below the minimum required pressure. This means that an instrument which is required to fully control, not just vent, at zero bar gauge, requires a negative pressure on the vent port.

If it is decided simply to use the instrument to vent down to zero bar g (no vacuum on the vent port), care must be taken not to demand zero pressure for more than approximately one minute. This is because the release valve will be operating outside its normal controlling mode and this in turn causes a build-up of heat in the valve. The valve is protected against failure in these circumstances by a temperature sensor, but operation of this sensor will disable the controller until the valve temperature falls. Repeated operation of this protection circuit will reduce reliability.

Avoiding Overshoot

To avoid overshoot use the 'AUTO' rate and set AUTO SPEED and AUTOMAX for optimum performance, see 3.9.2.

Filling and Venting Times

The user will often want to estimate how long it will take to reach a certain pressure in a system using this instrument. Many factors affect the rate at which the instrument will pressurise or evacuate the user's system, such as:

- **Supply Pressure and Outlet Pressure** viz. differential pressure across the control valve. This is the 'motive force' which drives gas through the valve orifice. Assuming the supply pressure is constant, then the differential pressure falls as the outlet pressure rises. Thus the flow through the valve is not constant as the user's system is filled.

- Controller RATE Setting - (see 3.9.2). Assuming the system volume is small such that flow rate through the control valves does not limit the fill time, then the controller RATE setting will determine the dynamic performance. The RATE settings are:

MAX	-	for the fastest response but with overshoot
AUTO	-	giving slower operation without overshoot.
RATE	-	giving a linear ramp rate

Because of these variations, it is not possible to publish fill time figures. In practise small volumes such as one metre of pipe and a UUT can be filled to a good accuracy in less than one second. The controller takes a few seconds to achieve control, it is not possible to change pressure to the accuracy of this instrument instantaneously.

Maximising Valve Life

The control valves used in the instrument are very robust and give a good operating life. However, some operating conditions cause more wear to the valve seats or the thermal protection sensor and should, if possible, be avoided .

Valve life will be maximised when:

- The correct supply pressures are available to the instrument for the working output range (see page 3-21).

- The controller is turned off when it is not necessary to control the pressure precisely. Examples are when a test is complete at one pressure and there is a pause before moving on to the next pressure, turn off the controller in the pause. Also when a test is finished and the system is returned to zero pressure for the next UUT to be connected, do not leave the controller on at zero pressure turn it off during the change-over. This will increase valve life and the operator's safety.

Control at Zero Gauge Pressure without a Vacuum Pump

As mentioned under 'Optimum Source and Vent Pressures' the instrument should have a negative pressure applied to the vent port for correct operation at zero gauge (atmospheric) pressure. However, zero will be achieved without this pressure providing the following are considered.

- Controlling under these circumstances may result in increased acoustic noise from the instrument.
- Associated with the increased noise is increased wear on the valve.
- If the condition is maintained, the controller may switch itself off automatically to protect the valves against overheating.

These limitations may be minimised by:

- Monitoring the pressure reading and turning off the controller when zero has been reached or as soon as practical thereafter. Continuing to monitor the pressure and turning the controller on again should the pressure increase, as may be caused by temperature rise in the system. This is particularly effective when the instrument is computer controlled.

- Minimising the system volume and/or using external apply and release valves so as to reduce the time to reach zero pressure.

3.9 Set-up Mode

3.9.1 General

Set-up mode is used to set up the instrument's default control parameters to those required for the particular mode of operation. When the instrument is delivered, a number of default parameters are set, some of which may need to be changed for specific applications. Set-up uses the keypad on the front panel of the instrument to program these operating parameters. Access to the set-up mode can be restricted against unauthorised entry by a four digit Personal Identification Number (PIN). When the equipment is first supplied, no PIN is entered.

Set-up comprises a menu structure, the highest level of which divides into three basic menus termed **Menu, Comms** and **More**. Each of these menu options further divides into a number of sub-levels, giving access to specific parameters. Figure 3.11 shows the menu hierarchy and gives an overview of the functions accessed under each menu option. A detailed description of the set-up procedures covered under each menu option follows.

Each sub-menu provides a range of option statements for the programming of functions and options. The functions are extended to one of three function keys labelled **F1**, **F2** and **F3.** Pressing the appropriate function key selects the allocated function as summarised below.

Alter Select the next option (e.g.) a baud rate, from the list of options allocated to that function. Where only two options are provided, **Alter** will toggle between the options.

Next Moves to the next function down under the current option.

Quit Returns to the menu level.

Enter Request for entry of a numeric value. Enter value from numeric keypad, terminating entry with **Enter** (←).

Yes Immediate action implemented.

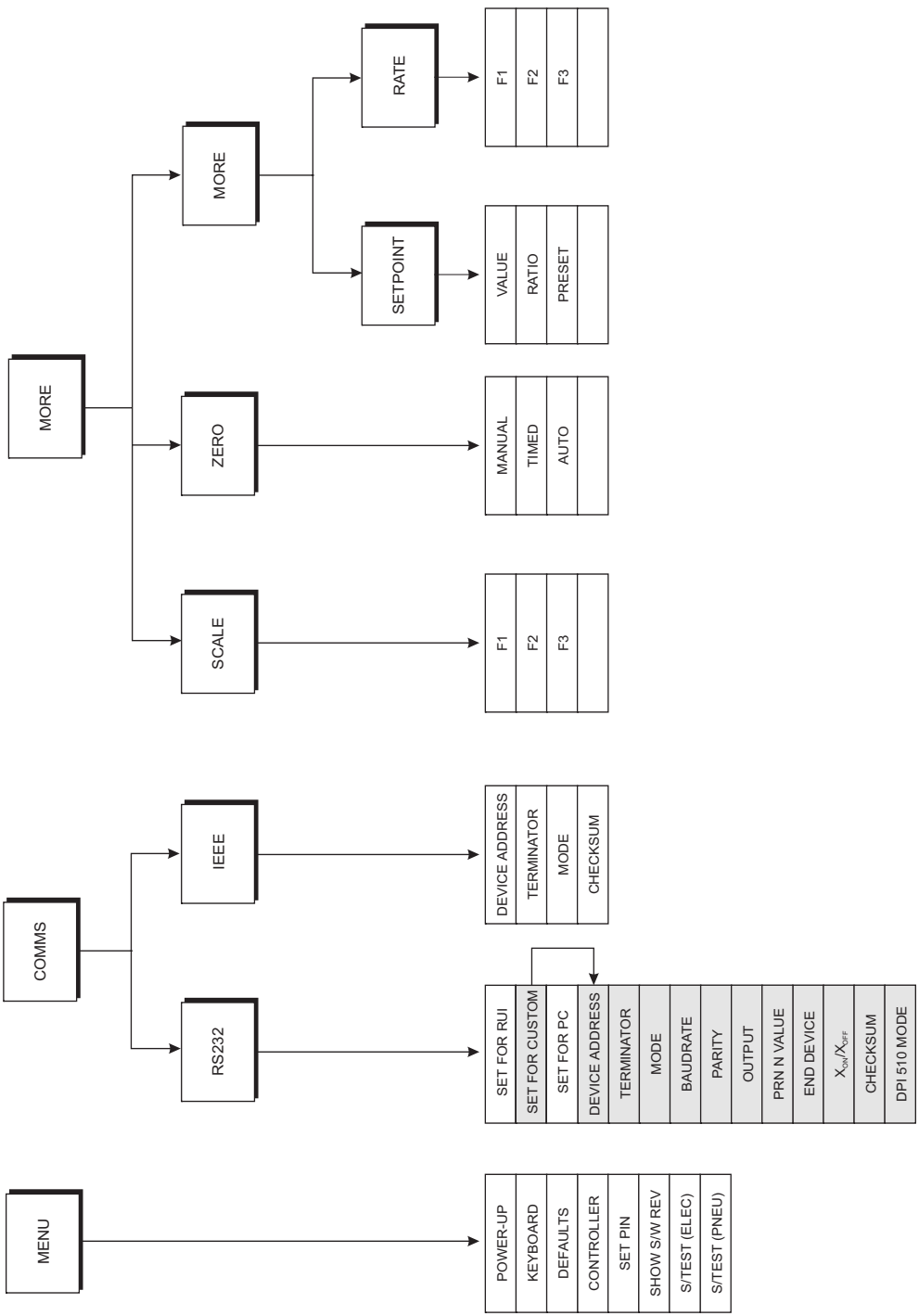


Figure 3.11 - Set-up Menu Structure

3.9.2 Set-up MENU

When the instrument is first delivered there is no PIN set. Any of the top level SETUP menu options can therefore be entered by operation of the SETUP key. A prompt showing the available menu options will be presented as follows (e.g.),

Setup Mode

Menu Comms More

Select Menu (F1) for access to the sub-menus available under this option. Figure 3.11, shows the sequence of option selection, details of each option being described below. Parameters given in brackets indicate the factory set default value.

Power-up (Reset)

The power-up parameter can have one of two values, **Reset** or **Restore.** When selected, the current status is indicated and a prompt to change is given (e.g.),

Power-up: Reset

Alter Next Quit

Alter (F1), toggles the parameter value between the available options (**Reset** and **Restore**). Using **Alter** (F1), select the required parameter and either press **Next** (F2) to move on to the next function or **Quit** (F3), to return to the **Setup Menu.**

Reset: Ensures that the instrument powers up in a known “safe” reset state as follows,

Scale 1, Controller Off, Set-point (Zero), Rate 1.

Restore: When selected, causes the instrument to power-up, recalling the operating conditions which were stored at the last “Store Defaults” operation (See Recall Defaults). This selection recalls the operating conditions of the **set-point, controller, tare, zero, value, ratio, preset** and **rate** parameters.

Keyboard (Unlocked)

The keyboard parameter can have one of two states **Locked** or **Unlocked.** When selected, the current status is indicated and a prompt to change is given (e.g.),

Keyboard:	**Unlocked**	
Alter	**Next**	**Quit**

Alter (F1), toggles the keyboard status between the available options (**Unlocked** and **Locked**). Using **Alter** (F1), select the required status and either press **Next** (F2) to move on to the next function or **Quit** (F3), to return to the setup menu.

The keyboard lock parameter should not require changing since the PIN effectively prevents any unauthorised access to the setup parameters.

Recall Defaults ?

Initially, when the instrument is delivered, a full range of factory set defaults will have been entered for the instrument. During the course of installation, these defaults will probably be changed. The **Recall Defaults** option provides a facility to either recall the original set of default values or to overwrite the original default values with any new values entered during set-up and commissioning.

CAUTION: Once any default value has been overwritten, the original value is lost. After an overwrite operation, the only way of recovering a previous set of defaults is to have recorded them prior to overwriting and then to physically re-enter them.

When **Recall Defaults ?** is initially selected, three options are made available as follows (e.g.),

Recall Defaults ?
Yes **Next** **Quit**

Select **Yes** (F1) to recall the previous set of stored default values.
The parameters affected will be controller, scale, zero, set-point, value, ratio, preset and rate.

NOTE: *This will cause any of the above parameters, changed since the last recall defaults operation, to be overwritten with the original default value.*

Select **Next** (F2) if any of the current set of default parameters are required to be set as default values in place of the original set, i.e. store current set-up. Selection of **Next** provides a prompt to replace (store) the default values (e.g.),

Replace defaults ?
Yes **Next** **Quit**

Select **Yes** (F1) to accept (store) the current values as defaults, **Next** (F2), to move on to the **Set up Controller** menu options (without storing new defaults), or **Quit** (F3) to return to the main set-up menu.

NOTE: *It is recommended that the operation of storing defaults i.e. current set-up, be carried out only after installation of the instrument has been completed and the system tested. Do NOT power off before storing a set-up or all current values (excluding COMMS set-up) will be lost.*

Set-up Controller

Changes to the controller set-up allow adjustment of the control loop stability, auto-speed and auto-max parameters. Stability may require adjustment depending on the system volume being controlled and auto-speed and auto-max, depending on the required step response. The option to change the controller parameters is given by the following prompt.

Set-up Controller ?
Yes **Next** **Quit**

Select **Yes** (F1) to change the controller parameters which are then presented in the following order.

Stability

The controller stability factor may require adjustment when the system volume is changed. The stability setting is typically, between 25 and 200. Following installation, to check the controller stability value for a given system volume, proceed as follows.

(i) Record the stability setting of the controller by entering the set-up controller menu and reading the stability value. Quit the set-up mode.

(ii) Program a set-point of zero and the controller to ON.

(iii) Program a set-point of 80% F.S. If the controller oscillates on reaching the demanded pressure, the stability setting is too low. If, on reaching the set-point, low frequency drift about the set-point is occurring, the stability setting is too high.

(iv) Select set-up again and enter the set-up controller menu. If too high a value of stability is indicated by the check, enter a new value of half the current setting and recheck the controller stability as detailed in (ii) an (iii) above. Repeat if necessary, increasing the entered value by 10 each time until the required stability is achieved.

If too low a value is indicated by the stability check, double the current setting and recheck stability as detailed in (i) and (ii). Repeat if necessary, decreasing the value by 10 each time.

(v) When satisfactory controller stability is achieved, check the controller stability for an applied negative pressure step by programming a negative step from a set-point of 80% full scale to 20% full scale. Check that the controller acquires the demanded pressure without either oscillation or low frequency drift about the set-point. Readjust the stability setting if required.

- **Autospeed (1)**

  Auto-speed sets the maximum rate of change (exponential rise time), that can be made in a single step between any setpoint value and another. Auto-speed can be programmed between **0.1** (slow) and a maximum of **1** (fast). The upper setting corresponds to 63%.

  Press the **Alter** (F1) key and in response to the **Enter New Autospeed** prompt, enter the required factor on the numeric keypad and press the **Enter** (←) key. Select **Next** (F2) to move on to **Automax** or **Quit** (F3) to quit set up of further controller parameters and move on to the **Set PIN** function.

- **Automax (1)**

  Auto-max sets the maximum step (as a percentage of full scale) that can be applied from any setpoint. Auto-max can be programmed between **0.1** (slow) and a maximum of **1** (fast). The upper setting, (**1**) corresponds to a step of 100% F.S.

  Press the **Alter** (F1) key and in response to the **Enter New Automax** prompt, enter the required factor on the numeric keypad and press the **Enter** (←) key. Select **Next** (F2) to recycle through the controller parameters set or **Quit** (F3) to move on to the **Set PIN** function.

Set PIN

A personal identification number (PIN) should be set to protect the instrument set-up parameters from unauthorised change. As delivered, the instrument has no PIN set. On entering the **Set PIN** menu option, the following prompt is given (e.g.),

Set PIN?
Yes **Next** **Quit**

To set a PIN, select **Yes** (F1) and in response to the **Enter New Pin,** enter a four digit number via the keypad. The number entered is written to the display. Check that the number on the display is the one required and press **Enter** (←). The menu set-up then moves on to the next option (**Show S/W Revision**).

To remove the PIN protection, enter a PIN of 0000.

Show S/W Rev?

This option causes the software part number and revision to be written to the display (e.g.),

DK144 3.00

Next Quit

Self Test: Electronic

This set-up option forces the instrument to carry out a self test operation on it's RAM, EPPROM and EEPROM, checking checksum values against known values. On entering this menu option the following screen is presented.

Self Test: Electronic

Yes Next Quit

Selecting **Yes** (F1) starts the test. The result can either be a pass or reported fail condition (e.g.).,

Self test passed

Or error conditions:

Eprom failure
Ram failure
Cal Checksum Error

The first two error conditions indicate an error requiring service attention. Refer to Section 5 for details of calibration.

The electrical self test facility is automatically started at power up. During normal operation, should any of these faults occur, the error condition will be written to the display. A pass is not reported at power-up.

Self Test: Pneumatic

This instrument leak test should only be carried out when the controller has been fully installed. The following system conditions should therefore exist.

(i) Source pressure connected and turned on.

(ii) External system connected.

(iii) Vacuum supply to vent port (if used) turned on.

(iv) The instrument is thermally stable.

On entering this menu option the following screen is presented.

Self Test: Pneumatic

Yes Next Quit

Selecting **Yes** (F1) starts the test. During the test, the isolation valve closes and the controller goes to 2.5 bar or F.S. whichever is lower. The controller controls the output at this level for 60 seconds and then switches off. The instrument then waits for 30 seconds and measures over the next 15 seconds to perform a leak test. The system is then restored to the last measured value prior to selection of the test.

The measured leak rate is written to the display in displayed units per minute (e.g.)

Leak rate: 0.0145 bar/min

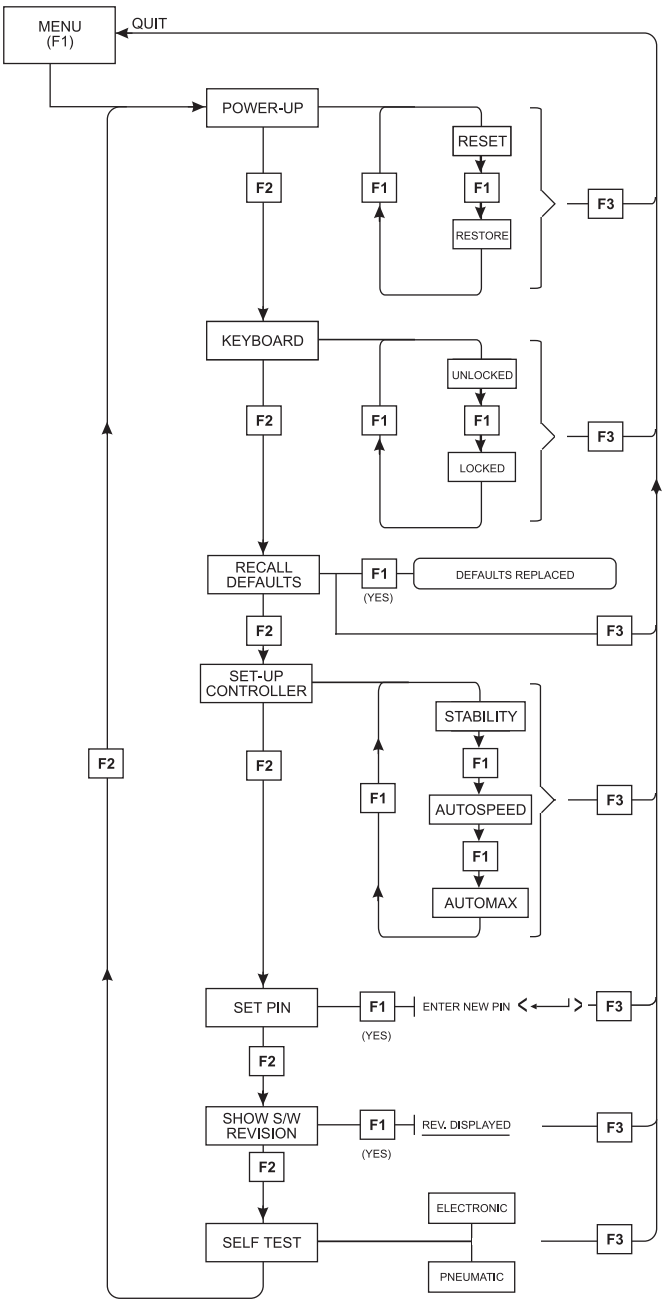


Figure 3.12 Menu Set-up Options

3.9.3 Set-up COMMUNICATIONS

Selection of the **Comms** option (F2) from the **set-up menu,** provides access to the parameter set-up facilities for both the RS232 and IEEE 488 communications interfaces. Figure 3.11 summarises the parameters accessed by each menu option. Access to the options in each menu are controlled by three function keys, labelled **F1, F2** and **F3,** their functions being described in Section 3.9.1.

When either an RS232 or IEEE 488 parameter is changed during set-up, the change is immediately stored. If the instrument is subsequently switched off, when it is next powered up, the last set of communications parameters entered are recalled, regardless of whether the **Power-up** parameter (see Section 3.9.2) is set to **Reset** or **Restore**.

- **IEEE 488 Set-up**

  To access the IEEE 488 parameter set-up menus, select set-up, enter the PIN (if allocated) and select **Comms** (F2) from the main menu. Selection of **Comms** provides a choice of either RS232 or IEEE 488 as follows.

  Setup Comms

  RS232 IEEE Quit

  Select **IEEE 488** (F2) and immediately the first of the IEEE 488 parameters will be presented for change (e.g.),

  Device Address: 16

  Alter Next Quit

  Use the **Alter** (F1) key to change the address and a prompt for a new value is given (e.g.),

  Enter new value

Enter the new value via the numeric keypad and press the **Enter** (←) key. Use the **Next** (F2) key to move on to the next (terminator) or subsequent options and the **Quit** (F3) key to exit the menu.

The remaining IEEE 488 parameters are selected by toggling the **Alter** (F1) key. Figure 3.13 shows the key sequence for setting up the various parameters and the options available for each parameter. The values shown at the top of the each listing represent the factory set defaults.

- **Mode (DPI 500/DPI 510 Emulation)**

  The DPI 520 instrument can emulate either the Druck DPI 500 or DPI 510 instruments in terms of communication protocol. This parameter should remain set at **DPI 520** unless there is a specific requirement to emulate either of these instruments.

- **Terminator**

  The **Terminator** parameters, are set up via the RS232 Comms menu as shown in Figure 3.14.

- **Checksum**

  The **Checksum** parameters, either NONE, AUTO, or ALWAYS are set up via the RS232 Comms menu as shown in Figure 3.14.

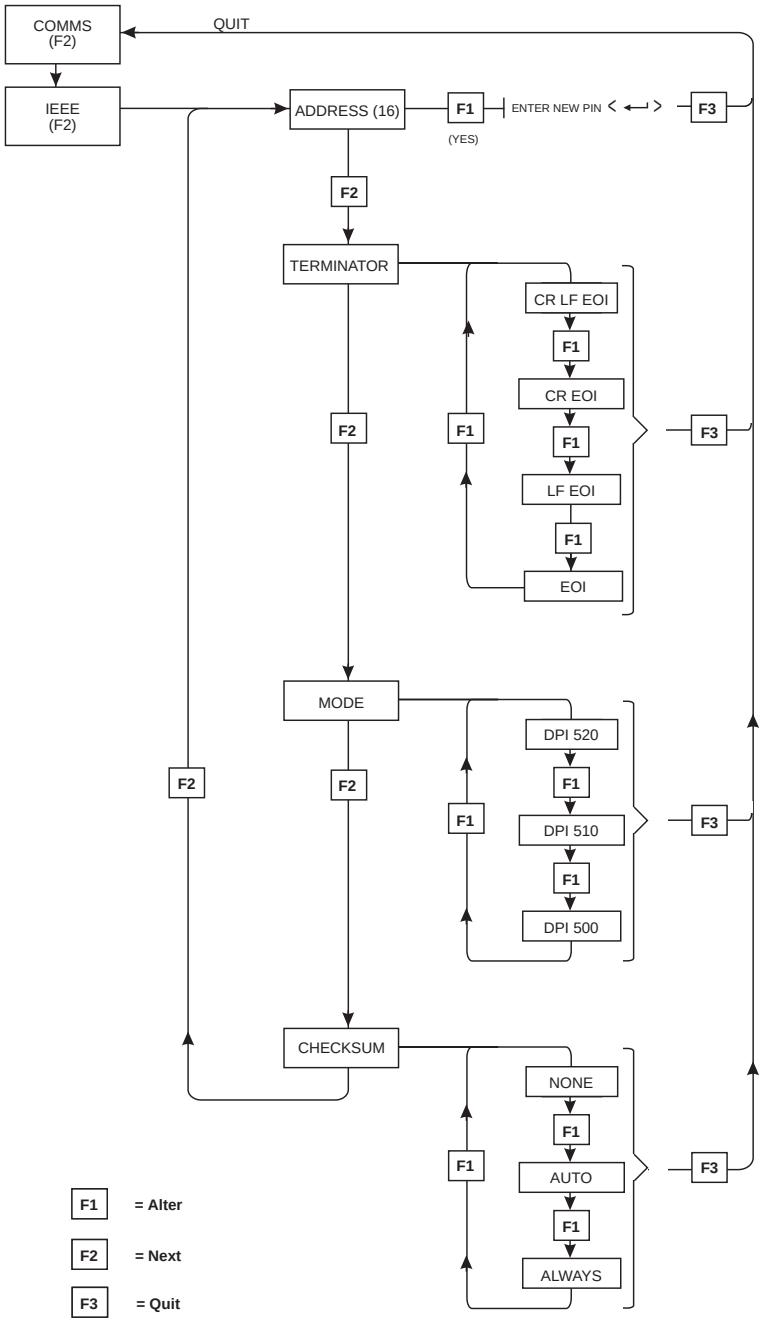


Figure 3.13 IEEE 488 Set-up Menu

RS232 Set-up

To access the RS232 parameter set-up menus, select set-up, enter the PIN (if allocated) and select **Comms** (F2) from the main menu. Selection of **Comms** provides a choice of either RS232 or IEEE 488 as follows.

Setup Comms
RS232 IEEE Quit

Select RS232 and immediately, the control settings, either RUI, PC or CUSTOM (default setting PC), will be presented (e.g.),

RUI

This setting is used to quickly adjust the RS232 interface to work with a RUI 100 or RUI 101. To complete the RS232 set-up for RUI use, the instrument must be given a unique address number. The address number can be in the range 1 to 16 and must be different to the address entered on any other DPI520s connected to the RUI. If only the one controller is to be connected to the RUI, the address does not need to be set.

To set the address, press the **Alter** (F1) key and then enter the address number and quit.

PC

Selects a set of communications parameters for RS 232 which are often used by a PC system. The parameters set up by this setting are:-

Terminator:	CR/LF
Mode:	Direct
Baudrate:	9600
Parity:	None
Output:	Computer
End Device:	No
X_{ON}/X_{OFF} :	Disabled
Checksum:	Auto
DPI 510:	No

- **Custom**

This selection allows the user to set-up all the RS 232 parameters as desired. The method of selection is shown on Figure 3.14. The parameters are:-

Address - Used to set up a unique address in the range 0 to 99 for an individual controller. Applicable only when using Addressed Mode (see Mode).

Terminator - Used to set-up character appended to each output data packet. Choice of the following provided:-

CR	Carriage Return
LF	Line Feed
CR/LF	Carriage Return and Line Feed (both)

Mode - Used to select method of operation. Choice of either, Direct, Addressed or Printer.

Direct

Used for one to one communication applications.

Addressed

Used for applications where more than one controller is connected to a loop. A unique address, in the range 0 to 99, must be allocated to each controller on the loop using the **Address** function.

Printer

Used to continuously output data to a printer. Frequency of output depends upon PRINTER N VALUE setting which can have a value within the range 1 to 9999.

1	Values output after every update
2	Value output after every 2 updates
3	Value output after every 3 updates
etc.	Value output after a maximum value of 9999 updates

Baud Rate - Allows data transfer rate to be selected. Baud rates available are 110/150/300/600/1200/2400/4800/9600/19200.

Parity - Allows selection of parity checking method. Choice of Odd/Even or None.

Output - Selects data output mode. Two options are available, Computer and Dialogue.

Computer: Returns readings as values.

Dialogue: Returns readings in English Text

End device - Marks an instrument as the last device on a daisy chain. Designed to stop characters being echoed back roud the loop. Command takes one of two values **YES** (this is the end device) or **NO** (Not an end device).

XON/XOFF- - Used for software handshaking applications. The command takes one of two values, **Enabled** or **Disabled**. Connections between an instrument and host computer are shown on pages 3-12 to 3-16.

Checksums - Determines circumstances under which a checksum is added to data packets for transmission error detection purposes. Takes one of three values, None/Auto/Always.

None : No checksum added.

Auto: Checksum added to all data output by the instrument. Input (commands) can have a checksum or not. If a checksum is present then it must be correct.

Always: Checksum added to output and is mandatory on input data.

DPI 510 - This command enables a DPI 520 to emulate a Druck DPI 510 controller i.e. to recognise the DPI 510 command set. It takes one of two values YES or NO.

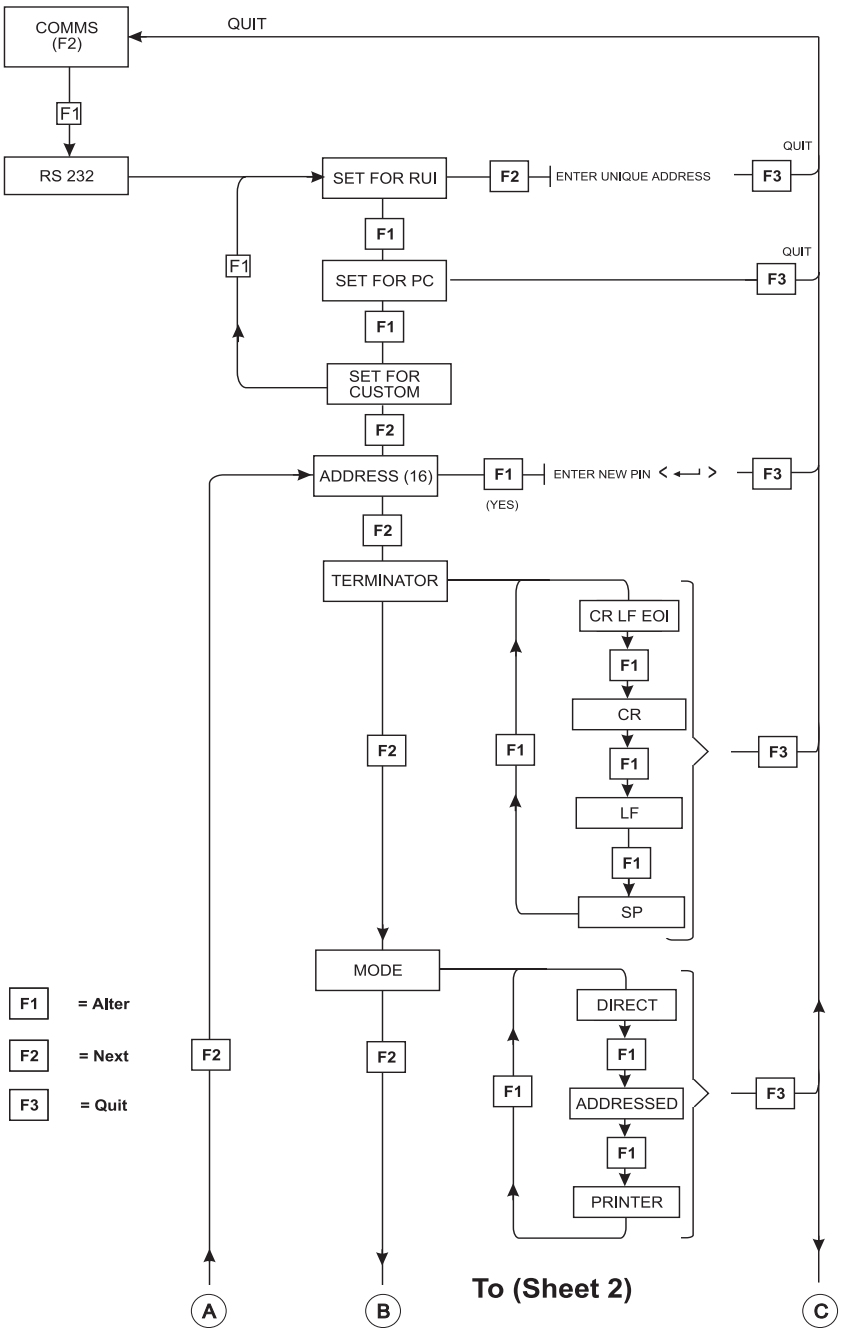


Figure 3.14 RS232 Set-up Menu (Sheet 1)

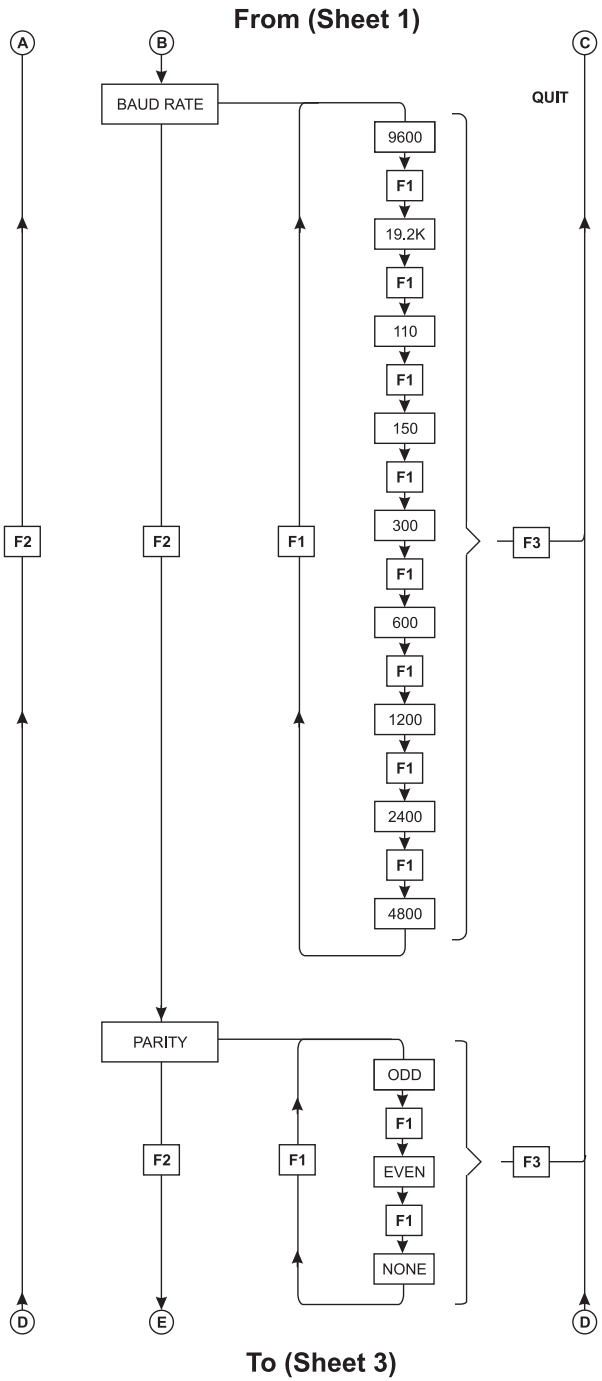


Figure 3.14 RS232 Set-up Menu (Sheet 2)

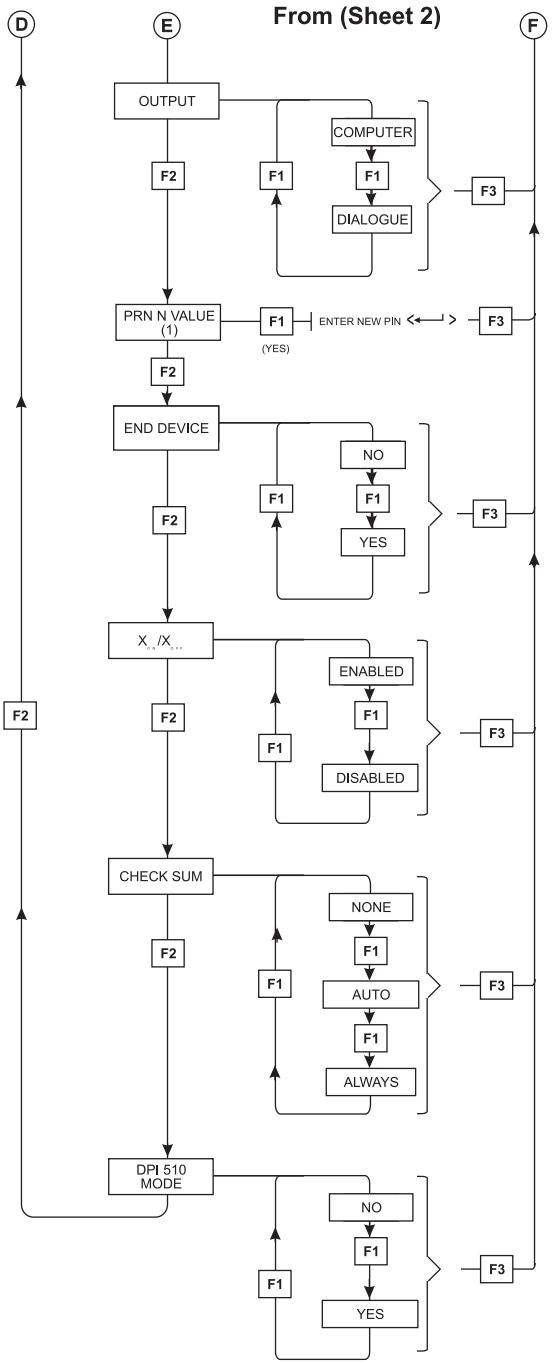


Figure 3.14 RS232 Set-up Menu (Sheet 3)

3.9.4 Set-up More (Scale, Zero, More)

The **More** option of the set-up menu, extends the set-up functions to the scale, zero, set-point and rate features of the instrument as shown in Figure 3.12. A brief summary of each of these functions is shown below. The set-up method for each parameter follows the summary.

- **Scale**

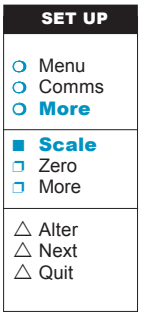
Scale permits three units out of a maximum of 24 to be set-up for selection. Under set-up, each of the three function keys, **F1, F2** and **F3** can be programmed with one of the available units. The control commands S0 through S2 will call the units programmed to these keys as follows

S0 calls	**Units allocated to F1**
S1 calls	**Units allocated to F2**
S2 calls	**Units allocated to F2**

Alternatively, the S3 command, followed by a U command and suitable argument allows full remote selection of any of the pressure scales.

Table 3.2 gives the full range of the available units and the corresponding U command argument required to select these units remotely.

Set-up Method (Scale)



- Press set-up key and enter PIN if required to display set-up menu.
- Select **More** (F3) and select **Scale** (F1) from the ***More*** menu.
- Select **F1** (F1) from scale menu.
- Use the **Alter** (F1) key to step through options available until the required units parameter is displayed against the F1 function key. Table 3.2 shows all available options.
- Press **Quit** (F3) key to quit to set-up menu or **Next** (F2) to move on to set up the next function key.
- Repeat for all function keys as required.

Unit	Symbol Unit
Pa	Pascal
kPa	kilo-Pascal
MPa	mega-Pascal
mbar	millibar
bar	bar
kg/cm^2	kilogram per square centimetre
kg/m^2	kilogram per square metre
mmHg	millimetre of Mercury
cmHg	centimetre of Mercury
mHg	metre of Mercury
mmH_2O	millimetre of water
cmH_2O	centimetre of water
mH_2O	metre of water
torr	1/760 x 1 atm (1 mm Mercury)
atm	atmosphere
psi	pound per square inch
lbf/ft^2	pound force per square foot
inHg	inch of Mercury
‘’H_2O04	inch of water @ 4°C
‘H_2O04	feet of water @ 4°C
SPEC’L	Special Unit
‘’H_2O20	inch of water @ 20°C
‘’H_2O20	feet of water @ 20°C
hPa	hecta-Pascal

Table 3.2 - Scale Units

Zero

There are three zero modes for the DPI 520, **Manual**, **Timed** and **Auto**. Each mode can be enabled and disabled under the set-up **More** option.

Manual Zero

The manual zero facility enables the instrument to be instructed to perform a zero operation by the **O** command (**O1**). Two versions of a manual zero are available.

(a) Zero without closing the isolation valve (when manual zero is set to **Enabled**).

(b) Zero after closing the isolation valve (when manual zero is set to **Isolated**).

A wait period can be programmed for each option. The wait period is the period following a zero instruction, which is allowed to elapse before the zero operation is carried out. This period is to allow sufficient time, after the opening of the vent valve, for the pressure to collapse and reach zero. This period will depend on system volumes.

NOTE: *In applications where a number of controllers are connected to a common port, Manual Zero (Isolated) must be selected and Timed and Auto zero set to OFF.*

Timed Zero

A timed zero is an automatic zero which takes place after a user programmable period of time has elapsed (default value: 30 min). The zeroing sequence is as follows.

(a) Isolation valve closes.

(b) Instrument vent valve opens.

(c) After a (user programmable) delay period, to allow sufficient time to establish zero pressure, the zeroing operation is carried out.

(d) The controller re-establishes output pressure at the level existing immediately prior to the timed zero taking place.

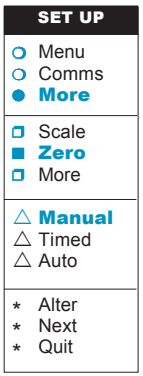
(e) The isolation valve is opened to reconnect the controller to the system.

NOTE: *The timed zero option should be set to OFF when more than one controller is operating into a common manifold. It should also be set to OFF when the AUTO zero mode is enabled.*

Auto Zero

When selected, the auto zero mode causes the instrument to perform an automatic zero every time an aim of zero pressure is made.

Set-up method (Zero)



- Press set-up key and enter PIN if required to display set-up menu.
- Select **More** (F3) and select **Zero** (F2) from **More** menu.
- To set up the manual zero options, select **Manual** (F1) from **Zero** menu.
- Use the **Alter** (F1) key to toggle through options available (**Enabled, Isolated** or **Disabled** until the required mode parameter is displayed.
- Press **Quit** (F3) key to quit to set-up menu or **Next** (F2) to set up the required **Wait** time. The following prompt will now be displayed.

  Enter new wait (secs)

  Enter the required wait time on the numeric keypad and press the **Enter** (←) key.

- To set up the timed zero options, select **Timed** (F2) from the zero menu options.
- Use the **Alter** (F1) key to toggle through the available options, (**Off** or **On**) until the required parameter is displayed.
- Press the **Quit** (F3) key to quit to set-up menu or **Next** (F2) to set up the required zero period. The following prompt will now be displayed (e.g.),

  Enter new time (minutes): 30

Enter the required zero period on the numeric keypad and press the **Enter** (←) key. A prompt for the entry of a wait period will now be given (e.g.),

Enter new wait (secs): 30

Enter the required Wait time on the numeric keypad and press the **Enter** (←) key.

- To set up the auto zero options, select **Auto** (F3) from the zero menu options.
- Use the **Alter** (F1) key to toggle through the available options, (**Off** or **On**) until the required parameter is displayed.
- Press the **Quit** (F3) key to quit to set-up menu or **Next** (F2) to set up the required wait period. The following prompt will now be displayed (e.g.),

Enter new wait (secs): 30

Enter the required wait period on the numeric keypad and press the **Enter** (←) key.

3.9.5 More (Set-point and Rate)

The **More** (F3) option of the set-up more menu provides access to the set-point and rate set up menus as shown in Figure 3.12. A brief summary of these functions follows.

- **Set-point**

The set-point set-up facility provides access to three set-point modes, value ratio and preset.

- **Value**

The value option of the set-point menu sets the value of the minimum and maximum set-point limits that can be demanded by the **P** command. The default values are zero and 1.1 times the full scale pressure of the instrument. Any values within this range can be programmed under set-up.

NOTE: *The figures entered are in the selected pressure units (e.g.), for a 2 bar instrument, the factory programmed default would be 0 bar (minimum) and 2.2 bar (maximum).*

Ratio

Selecting the **Ratio** mode from the set-point option provides a sub-menu of twelve ratios (figures represent a percentage of current set-point). The factory default values for these ratios provide 10% steps from zero to 110% of current scale reading. Set-up provides the facility to set each of these ratios to any figure, within the range 0 to 110 %.

The ratios are numbered **Ratio %0** through **Ratio %11**. These ratios are called by the **/0** through **/11** commands, **/0** calling **Ratio %0** and **/11** calling **Ratio %11.** Ratio is expressed as a percentage of current scale reading i.e., if the instrument is currently controlling at 50% F.S. pressure, selection of **Ratio %5** (50%), would result in a set-point of 25% F.S., (50% of current reading (50%)).

Preset

Selecting the **Preset** mode from the set-point option provides a sub-menu of twelve ratios (figures represent pressure in current units). The factory default values for these ratios provide twelve, 10% F.S. pressure steps from zero to 110% of full scale (e.g.) for a 2 bar F.S. instrument **Preset %0** would be set to 0 bar, **Preset %1** to 0.2 bar and **Preset %11**, 2.2 bar. Set-up provides the facility to set each of these preset pressures to any desired pressure value within the range 0 to 110 % F.S.

The presets are numbered **Preset %0** through **Preset %11**. These ratios are called by the ***0** through ***11** commands, ***0** calling **Preset %0** and ***11** calling **Preset %11.** If, for example, a 2 bar instrument was controlling at 50% F.S. pressure (1 bar), selection of **Preset %11** (2.2 bar), would result in a new set-point of 110% F.S. (2.2 bar), being established. The controller output would move to this level at a rate determined by the **Rate** settings.

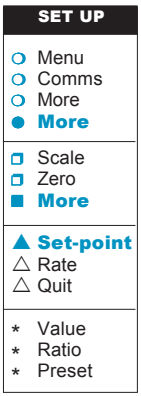
Rate

Rate provides three possibilities to be set-up for selection. Each of the three function keys, **F1, F2** and **F3** can be programmed with one of three options, **Max**, **Auto** or a **Variable** value rate. The control commands J0 through J2 will call the units programmed to these keys as follows.

J0 calls	F1 (default Max)
J1 calls	F2 (default Auto)
J2 calls	F3 (default 10% F.S. Units/sec)

Maximum implies a rate within the Min/Max set-point settings. Auto provides a critically damped rate, governed by the settings of the **Autospeed** and **Automax** parameters (refer to controller set-up Section 3.9.2).

Set-up method (set-point)



- Press **Set-up** key and enter PIN if required to display set-up menu.
- Select **More** (F3) and select **More** (F1) from more menu.
- Select **set-point** (F1) from menu displayed. A prompt will now be displayed requesting selection of one of three modes, **Value, Ratio** and **Preset** (e.g.),

  Select Mode
  Value Ratio Preset

- Select the required mode by pressing the appropriate function key. Each option is described in turn below.

Value

- After selection of **Value** option (F1), the current minimum value will be displayed, together with the change menu. The default value is zero (e.g.),

  Min = 0.0000
  Alter Next Quit

- Select **Alter** (F1) to change minimum value and in response to the prompt **Enter new min** enter the required value on the numeric keypad and press **Enter** (←).
- Select **Next** (F2) from menu to move on to set up the **Max** parameter. Press **Quit** (F3) to exit mode.

Ratio

- After selection of **Ratio** option (F2) from the set-point menu, the current value for **Ratio % 0** will be displayed, together with the change menu. The default value for this parameter is zero (e.g.),

Ratio %0 = 0.0000
Alter Next Quit

- Select **Alter** (F1) to change this value and in response to the prompt Enter New **Ratio %0**, enter the required value on the numeric keypad and press **Enter**(←).

- Select **Next** (F2) from menu to move on to set up the next parameter (**Ratio %1)** and subsequent ratio parameters, **Ratio % 2 to Ratio %11** a similar way. When all changes have been made press **Quit** (F3) to exit mode.

Preset

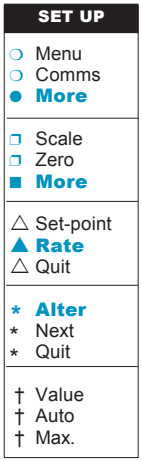
- After selection of **Preset** option (F3) from the set-point menu, the current value for **Preset %0** will be displayed, together with the change menu. The default value for this parameter is zero (e.g.),

Preset %0 = 0.0000
Alter Next Quit

- Select **Alter** (F1) to change this value and in response to the prompt **Enter New Preset %0**, enter the required value on the numeric keypad and press **Enter** (←).

- Select **Next** (F2) from menu to move on to set up the next parameter (**Preset %1)** and subsequent ratio parameters, **Preset % 2 to Preset %11** a similar way. When all changes have been made press **Quit** (F3) to exit mode.

Set-up Method (Rate)



- Press **set-up** key and enter PIN if required to display set-up menu.
- Select **More** (F3) and select **More** (F1) from more menu.
- Select **Rate** (F2) from menu displayed. A prompt will now be displayed showing the status of the F1 function together with a change menu (e.g.),

  F1 = Max
  Alter Next Quit

- Select **Alter** (F1) to change this value and a further menu is presented as follows (e.g.),

  Select F1: Mode:
  Value Auto Max

- Select either **Auto** (F2) or **Max** (F3) to assign either of these functions to F1 or, to assign a value to F1, select the **value** key. This starts a further dialogue as follows (e.g.), **Note:** the reported units will be those currently selected.

  Enter rate bar/sec

- Select **Rate** (F2) from menu displayed. A prompt will now be displayed showing the status of the F1 function together with a change menu.
- Enter the required value on the numeric keypad and press **Enter** (←).
- Press **Quit** (F3) key (if displayed) or **DEL** to quit rate set-up mode.

4 OPERATION

This instrument is normally operated in remote mode using IEEE or RS232. Local mode is used for instrument set-up and calibration purposes only. No operational commands (e.g.) set-point or tare values can be entered via the keyboard. Control can only be effected in remote mode either via the IEEE 488 or the RS232 serial interface ports.

Both ports share a common communication language based on the ASCII character set. However, due to the physical differences between the two interfaces there are additions to the RS232 command set for emulating the hardware features of the IEEE interface.

4.1 Local Mode

This mode is entered as soon as the instrument is switched on and before any control codes have been issued. If the instrument is currently operating in the remote mode, to return the instrument to Local mode, either a **R0** or **M** command must be issued over the communications interface.

The set-up and calibration facilities, which use the local control mode, are fully described in Section 3.9 and Section 5 respectively.

In Local mode, the instrument keyboard is enabled. Some RS232/IEEE commands are operational in Local mode, essentially those which only request data and thus do not affect operation.

4.2 Remote Mode

In this mode, the front panel keypad is locked out and the full command set is available over the control interfaces.

4.3 Control Codes

Control codes sent to the instrument cause it to respond in accordance with the command sent. Control codes are sent to the instrument over the RS232 and IEEE 488 communications interfaces. The control codes consist of shared codes, which are common to both RS232 and IEEE 488 and other codes which are either RS232 or IEEE 488 specific. Table 4.1 gives a list of shared control codes. The following sections describe each group of commands in the order in which they appear in Table 4.1. An asterisk (*) indicates that the command is covered in Set-up, (Section 3.9).

4.3.1 Control Code Format

All values are coded as the ASCII equivalent commands and may be sent individually or in strings.

Symbols used to describe these ASCII codes are:

< > contain a parameter which is further defined.

[ ] additional optional values - command specific

“ “contain actual ASCII characters to be transmitted.

The string format is:

<CONTROL CODE>[<CONTROL SELECTION>][<CONTROL VALUE>] <TERMINATOR><DELIMITER>

Where:

<**CONTROL CODE**> is a single alpha character i.e. **“R”.** This code must always be included.

[<CONTROL SELECTION>] is a an integer value, which in conjunction with the **<CONTROL CODE>** specifies the operation of the command. This is a command specific value and for some commands is completely omitted.

[<CONTROL VALUE>] supplies any numeric values required for the command. The values take on the following format:-

“=”<SIGN><VALUE>
Where:

“=” is not mandatory.

<SIGN> is **“+”** or **<SPACE>** or no character for positive values and **<->** for negative values.

<VALUE> is ASCII numeric value.

<TERMINATOR> is **<CR>**, carriage return.
<DELIMITER> is not mandatory but can be any of the following:

“,” “;” “:” <SPACE>.

Example “R1,S0,P=123.45,W20”<CR>

Sets remote mode, units as on F1, pressure set-point 123.45, wait time 20 sec.

4.3.2 Implementation of Checksums

The RS232 and IEEE488 communication protocol on the instrument have a user selectable checksum option. This increases the validity of data transfer. The checksum protocol is bidirectional, the instrument can generate checksums for outgoing data and check checksums for incoming data.

Checksums should only be used in **Computer** mode.

Checksum definition

The checksum used is an ASCII character addition, mod 100, two digit (ASCII representation) checksum. This makes decoding by the host computer relatively simple. (e.g.),

The code to place the instrument into remote mode is R1. This can be broken down as follows:-

R - ASCII code 82
1 - ASCII code 49

Total = 131

Mod 100 = 31

Therefore, to send R1 with the checksum

R1|31 should be sent

The | signifies the start of the checksum.

Data from the instrument would be sent as follows:-

‘ -0.001REMR1S0D0|22’ *22 is the checksum*

Checksum setup

Under setup/comms/RS232 or IEEE (refer to Section 3.9.3) set the following values:

None - No checksum is used. This is equivalent to the comms on the DPI 510 pressure controller.

Auto - This causes the instrument to always send the checksum. However, on reception the checksum is only checked if appended to the command. If the checksum is incorrect then the command is not executed and a checksum error is generated.

Always - This is the most secure method, the instrument always generates a checksum, and always expects to see a checksum appended to the command. If the checksum is incorrect or the checksum is missing then the command is not executed and a checksum error is generated.

Checksum Errors

Checksum errors are generated by setting the 1st and 8th bit of the status byte (programming error and checksum bit).

NOTE: In DPI 520 mode all the status bits can be displayed since the status is displayed as a 2 digit hexadecimal number. In DPI 500 and 510 mode only, the first six status bits are displayed (2 digit octal).

Function	Command	Checksum	Action	Available In
Mode Select	M	77	Local Control	Remote/Local
	R0	30	Local Control	Remote/Local
	R1	31	Remote Control	Remote/Local
Scale	S0	31	Units on F1	Remote/Local
	S1	32	Units on F2	Remote/Local
	S2	33	Units on F3	Remote/Local
	S3	34	Units as defined by **U command**	Remote/Local
Units	U1 to U24	34 - 87	S3 Units selection	Remote/Local
Data Select	D0	16	Selects data source for N0/N1	Remote/Local
	D1	17	Selects data source for N0/N1	Remote/Local
	D2	18	Selects data source for N0/N1	Remote/Local
Notation	N0	26	Selects output data format	Remote/Local
	N1	27	Selects output data format	Remote/Local
	N2	28	Selects output data format	Remote/Local
	N3	29	Selects output data format	Remote/Local
	N5	31	Selects output data format	Remote/Local
	N7	33	Selects output data format	Remote/Local
	N8	34	Selects output data format	Remote/Local
Interrupt	I0	21	No Interrupt	Remote/Local
	I1	22	Error	Remote/Local
	I2	23	In Limit	Remote/Local
	I3	24	In Limit and Error	Remote/Local
	I4	25	End of Conversion	Remote/Local
	I5	26	Error and End of Conversion	Remote/Local
	I6	27	In Limit and End of Conversion	Remote/Local
	I7	28	In Limit, Error and End of Conv.	Remote/Local
Wait Value	W<Value>	87 + Value	Wait value	Remote/Local
Controller	C0	15	Controller OFF	Remote
	C1	16	Controller ON	Remote
Set-point	P<Value>	80 + Value	Set-point Value	Remote
Ratio	/0 to /11	95 - 45	Set-point ratio	Remote
Preset	*0 to *11	90 - 40	Set-point preset	Remote/Local
Error	@0	12	Disable error reporting	Remote/Local
	@1	13	Enable error reporting	Remote/Local
Rate	J0	22	Rate on F1	Remote
	J1	23	Rate on F2	Remote
	J2	24	Rate on F3	Remote
Rate Value	V<Value>	86 + Value	Rate value	Remote
Zero	O1	28	Zero	Remote
Tare	B<Value>	66 + Value	Tare value.	Remote
	T0	32	Tare OFF	Remote
	T1	31	Tare ON	Remote
Isolation Valve	E0	17	Close Isolation Valve	Remote
	E1	18	Open Isolation Valve	Remote
	F20	68	Close Isolation Valve	Remote
	F21	69	Open Isolation Valve	Remote

Table 4.1 RS 232 and IEEE Command Summary

4.4 Command Description

The following sections describe the commands in the order listed in Table 4.1.

4.4.1 Set to Local Mode - 'M'

This command places the instrument into local mode.

Example **“M”** Puts the instrument into local mode (see also R command).

4.4.2 Set Mode -'R'

This command places the instrument into either local or remote mode and turns the controller off. Value = 0 sets the instrument to Local and value =1, to remote mode.

Example **“R1”** Puts the instrument into remote mode.

4.4.3 Set Scale Units - 'S'

This command selects the pressure units. It takes the value 0 to 3. **S0** to **S2** select the units set-up for the function keys F1 to F3. **S3** selects the units configured by the U command.

Example **"S2"** Selects the units configured by the F3 function key.

4.4.4 Units - 'U'

Used in conjunction with the **S3** command, this command allows any of the instrument's units to be selected. The command takes a value which defines the required unit. See Table 4.2 for available units.

Example **"S3,U4"** Selects **mbar** pressure units.

4.4.5 Data Select - 'D'

The D command determines the source of data returned following a data request for Notations N0 and N1. It takes the value 0 to 2 as follows.

0 send current pressure
1 send current set-point (pressure demand)
2 send the reading on the front panel

Example **"D1"** Sets the data source as current set point.

4.4.6 Output Data Format - 'N'

Notation code selection. Selects the format of the data when data is requested from the instrument. The command takes the value 0 to 8 according to the required format. Refer for detail to Section 4.5.

Example **"N1"** Sets the data format to reading only.

Unit Symbol	Unit	U <argument>
Pa	Pascal	1
kPa	kilo-Pascal	2
MPa	mega-Pascal	3
mbar	millibar	4
bar	bar	5
kg/cm^2	kilogram per square centimetre	6
kg/m^2	kilogram per square metre	7
mmHg	millimetre of mercury	8
cmHg	centimetre of mercury	9
mHg	metre of mercury	10
mmH_2O	millimetre of water	11
cmH_2O	centimetre of water	12
mH_2O	metre of water	13
torr	1/760 x 1 atm (1 mm mercury)	14
atm	atmosphere	15
psi	pound per square inch	16
lbf/ft^2	pound force per square foot	17
inHg	inch of mercury	18
‘’H_2O04	inch of water @ 4°C	19
‘H_2O04	feet of water @ 4°C	20
SPEC’L	Special unit	21
‘’H_2O20	inch of water @ 20°C	22
‘’H_2O20	feet of water @ 20°C	23
hPa	hecta-Pascal	24

Table 4.2 - Scale Units

4.4.7 Interrupt - 'I'

The interrupt command sets the instrument to return a message when a specified event has occurred. It takes the value 0 to 7 to determine the event as follows.

0 No interrupt - all interrupts are disabled.
1 Interrupt on “Error”.
2 Interrupt on “In limit”.
3 Interrupt on “In limit” and “Error”.
4 Interrupt on End of Conversion”.
5 Interrupt on “Error” and “End of Conversion”.
6 Interrupt on “In limit” and “End of conversion”.
7 Interrupt on “In limit”, “Error” and “End of conversion”.

Error

This occurs when a command's syntax is not understood or the command's parameters are out of range.

In-Limits

When a new set-point is entered the wait timer is reset (see W command). When the reading is within 0.05 %FS of the set-point the wait timer is decremented once a second (if outside these limits then the timer is reset to its original value). When the timer reaches zero then in-limits signal is generated.

End of Conversion

Each time the instrument has a new reading (approximately 0.7 second) this event is generated.

Example **“I5”** Sets an interrupt on error and end of conversion.

4.4.8 Wait - 'W'

Selects the wait time before the in-limits signal is active. It takes a value which is the wait time in seconds (0 to 100).

Example **“W12”** Sets the in-limits wait time to 12 seconds

4.4.9 Controller On/Off - 'C'

Turns the controller on/off. it takes the value 0 or 1 as follows.

0 controller off
1 controller on

Example **“C1”** Turns the controller on

4.4.10 Pressure Set-Point - 'P'

This command allows a new pressure set-point to be entered. Its value is the new set-point in the current units. The control value is a number corresponding to the new set-point demand pressure in the current units.

Example **“P=10.5”** Sets the set-point to 10.5 in the currently selected units.

4.4.11 Ratio - '/'

This command sets one of the twelve preset division ratios. The current set-point is then divided by this ratio. The command takes the values 0 to 11. Refer to Section 3.9.5.

Example

If Preset 5 is set to 50% and the current set-point pressure is 20 bar then issuing the command,

“/5”

Sets the set-point pressure to 10 bar (50% of 20 bar).

4.4.12 Preset - '*'

This command selects one of twelve preset values. It takes the value 0 to 11. refer to Section 3.9.5.

Example **“*5”** Selects preset 5.

4.4.13 Error Reporting On/Off - '@'

This command turns error reporting on or off. It takes the value 0 for OFF and 1 for ON. When turned ON, errors are reported as part of data output as defined in Section 4.5.

Example **"@1"** Enables error reporting.

4.4.14 Rate -'J'

Selects the rate of change of pressure used to achieve set-point. The rate is as programmed on the function keys.

0 rate programmed on key F1.
1 rate programmed on key F2
2 rate programmed on key F3

Example **"J1"** Selects the rate programmed over the F2 function key.

4.4.15 Zero Instrument - 'O1'

This command initiates a manual zero on the currently selected pressure range.

Example **"O1"** Zero's the current pressure range.

4.4.16 Rate Value - 'V'

Sets the rate to a value in current units per second. The rate is automatically set to variable rate. This value is not stored in non volatile memory.

Example **"V=1.2"** Sets rate to 1.2 units per second.

4.4.17 Isolation Valve Open/Close - 'E'

Controls the state of the isolation valve. It takes the value 0 for closed and 1 for open.

Example **"E1"** Opens the isolation valve.

4.4.18 Open Isolation Valve -'F'

This command has been implemented for compatibility with the Druck DPI 510 pressure controller. It takes the value of either **20** (Isolation valve closed) or **21** (Isolation valve Open). Functionally, it controls the state of the isolation valve in the same way as the "E" command:-

Example "F21" (Functionally the same as **"E1"**) Opens Isolation valve

4.4.19 Tare Value -'B'

This command sets a value to be tared from the measured pressure. It takes the value of the tare in current units.

Example "B1013 " Sets the tare value to 1013 in current units.

4.4.20 Tare On/Off - 'T'

This command initiates the subtraction of the tare value from the measured pressure. It takes the value 0 for OFF and 1 for ON.

Example "T1" Turns on the tare

4.5 Output Code Format

The data sent consists of a data string of ASCII characters followed by the terminating characters programmed from the front panel.

The general format is:

<DATA><TERMINATOR>

Where:

<DATA>depends on Notation code/secondary address

<TERMINATOR> is one of the following, set from the front panel SET-UP:

<CRLF>
<CR>
<LF>
<SPACE>

Error conditions are indicated by "@" <Value>. The complete parameter is omitted in the absence of error or error reporting if disabled (control code @0).

The format is dependant on the preceding notation code.

NOTE: The numbers in brackets ( ) are the number of characters per item.

Notation Codes

Notation Code = N0

Format:

<value(7)><mode(3)><range(2)><scale(2)><value source(2)><error/status code(3)><terminator>

Example " 0.0007REMR1S2D1@01"

If no errors occur or error reporting is disabled then the error/status code is omitted.

Notation Code = N1

Format:

<value(7)><error/status code(3)><terminator>

Example " 0.0007@01"

If no errors occur or error reporting is disabled then the error/status code is omitted.

Notation Code = N2

Format:

<mode(3)><range(2)><scale(2)><value source(2)>
<controller status(2)><interrupt code(2)>
<isolation valve status(3)><terminator>

Example "LOCR0S1D2C0I3F21"

Notation Code = N3

Format:

<In limit status(1)><error/status code(3)><terminator>

Example "0@01"

If no errors occur or error reporting is disabled then the error/status code is omitted.

Notation Code = N4

Format:

<error status(2)><terminator code(2)><rate(2)>
<variable rate(8)><units(7)><terminator>

Example "@1E1J2V 0.0025U mbar"

Notation Code = N5

Format:

"DPI520"<accuracy(3)><fullscale(12)>":"
<serial number(7)><terminator>

Example "DPI520 A1 70.0000 barg: 2222."

Notation Code = N7

The status condition of the instrument is sent as:

<mode(3)><range(2)><scale(2)><value source(2)>
<controller status(2)><interrupt code(2)>
<notation code(2)><wait time(4)><terminator>

Example "REMR1S3D1C0I0N4W002"

Notation Code = N8

The full status condition of the instrument is sent as:

<mode(3)><range(2)><scale(2)><value source(2)>
<controller status(2)><interrupt code(2)><notation code(2)>
<wait time(4)><error status(2)><terminator code(2)><rate(2)>
<variable rate(8)><units(7)><tare(2),<tare value(8)><terminator>

Example "REMR1S3D1C0I0N4W002@1E1J0V+000001.U PaT1B+000010."

Parameter Definitions

Value = value selected by the “D” command, signed integer or floating point. When the instrument value is sent, the format is a 6 digit value plus decimal point. The value can be preceded by spaces to complete the 6 digit value. If the value is negative, a -ve sign is placed at the front of the value.

Mode = REM or LOC, remote or local

Range = R0 or R1 local or remote

Scale = S0 to S3 reports “S” status

Value source = D0 to D2 reports “D” status

Terminator = <CR><LF><SPACE>

Error/status code = present if error reporting is enabled and error present (“@” command)

Error code is stored as bits in a byte:

Bit 0 Command not accepted
Bit 1 Secondary address not available
Bit 2 Data string not valid
Bit 3 Reading in limits
Bit 4 Over range (reading exceeds transducer range or 99999
Bit 5 End of conversion
Bit 6 Valve over temperature
Bit 7 Checksum error

Controller status = C0 or C1, reports “C” status

Interrupt code = I0 to I7 reports “I” status

Isolation valve status = F20 Isolation valve off
F21 Isolation valve on

Notation code = N0 to N8 reports “N” status

Error reporting = @0 or @1 reports “@” status

Wait time = “W” followed by 3 digit ASCII value

Limit status = 0 or 1, 0 = out of limit, 1 = in limit

Terminator code = String terminator

where:

E0 : CR, LF
E1 : CR
E2 : LF
E3 : SPACE

Rate = Rate mode

where:

J0 : variable rate
J1 : auto rate
J2 : max rate

Variable rate = “V” + variable rate

Units = “U” + units in text

Accuracy = “ “ - standard
“ A1” - medium accuracy
“ A2” - high accuracy

Full-scale = full-scale of instrument in bar. The string also include the units and type:
g - gauge
a - absolute
d - differential

Serial number = configured serial number of instrument

Error/status Code

In the N0, N1 and N3 notation code settings, any error or status information changes occurring, if error reporting is enabled by control code @1, is indicated by the addition of @ value at the end of the data string.

Bit 0 Command not accepted - a command syntax error has occurred.
Bit 1 Secondary address not available. The instrument was addressed with a secondary address that it did not understand.
Bit 2 Data string not valid - The value returned by the instrument is not yet valid. This reading should be ignored (occurs when changing units and the instrument has not yet performed a new conversion).
Bit 3 Reading in limits - within the 0.05% FS tolerance - including wait time.
Bit 4 Over range (reading exceeds transducer range or 99999).
Bit 5 End of conversion - a new reading is available.
Bit 6 Valve over temperature - one of the valves has overheated and shut down. The controller will not operate correctly until the valve has cooled down.
Bit 7 Checksum error - the checksum sent to the instrument was incorrect. Therefore the command was not executed. (see Sections 4.8.4 and 4.8.5)

In DPI 520 mode, the error/status code is sent as an hexadecimal number representation of the error/status byte. In the DPI 500 and DPI 510 modes, bits 6 and 7 are not available and the error/status code is sent as an octal number.

Example **@01 indicates the code sent to the instrument was not executed.**

“Data string not valid” and “ Over-range” error flags are set and only reset when the error has been cleared.

4.6 RS232 Specific

The RS232 operates in two modes direct and printer. In the direct mode the instrument is connected by a point-to-point connection to an “intelligent” controller (control computer). In the printer mode the instrument provides data spontaneously on a timed basis to drive a “nonintelligent” peripheral such as a printer.

Data from the instrument can be in 'computer format ', compatible with computer interfacing or for diagnostic work or direct operation from a VDU, a 'dialogue format' is available which sends data as plain English text.

4.6.1 Operation Using RS232

To use the system:

(1) Choose the **Output Format:**

(a) Computer Format

In the computer format, a rigorous alphanumeric system of status conditions and readings are sent by the instrument.

NOTE: Cannot be used in printer mode.

OR

(b) Dialogue Format

All data is returned in plain English text.

(2) Determine the **Handshaking Method** required:

(a) Software Handshaking

RTS and CTS are not connected which reduces the number of connections between instruments. Refer to Section 3 for installation details.

OR

(b) Hardware Handshaking

This system uses the RTS and CTS signals from the instruments to control data flow.

Direct Mode

In the direct mode all control codes are acted upon as soon as they are interpreted. In addition sending <CR> will return a reading. The format of the returned data depends on the 'D' and 'N' command.

Printer Mode

The printer mode allows for the automatic and continuous output of data to a non-programmable device such as a printer.

In the printer mode, the output interval is programmed by the main instrument SET-UP menu as printer "N" value. A value of 1 programs the output of data on every new reading, a range of 1 to 9999 is available. A reading number is sent with each output of data.

The output of data takes the following format:

<Reading number>
PRESSURE = <Value><Units>
SET-POINT = <Value><Units>

where: <Reading number> is in the range 1 - 9999999.

Addressed Mode

Addressed Mode Control Codes

In the addressed mode all codes are available. In addition the following features concerned with access to one of several instruments are implemented.

Address

The address range will be 0-99. Each instrument will have an address and will be activated to respond to control data if the command string "#L"<address> where <address> is that instrument address. When so activated, the instrument is said to be a LISTENER.

Likewise, an instrument can be activated to send a data packet with its current reading by sending "#T"<address>. When so activated, the instrument is said to be a TALKER.

So that there can only be one TALKER on the ring at a time if a TALKER instrument detects the string "#T"<address> where <address> is not its own address then it will return to a passive state.

Assuming, for example that the address is set to 16 then :-

“#L16”	put the instrument into listen mode
“#T16”	causes the instrument to talk - send a reading depending on the ‘N’ and ‘D’ code.

Universal Commands

The following commands will be acted upon irrespective of the instrument being a TALKER or LISTENER:

#(UNL)	**Un-listen** will de-activate all LISTENERS.
#(UNT)	**Un-talk** will de-activate the current TALKER.
#(IFC)	**Interface Clear** will reset the communication link, clear all buffers and clear dialogue mode unless this is established by instrument set-up (see DIA below).
#(ADD)	This daisy chain RS232 command questions the address of instruments on the daisy chain. The instruments respond by transmitting their addresses. (e.g.) if address 15 and 16 are on the bus then the reply from this command would be {ADD15} {ADD16}

Addressed Commands

The following commands will be acted on only when the instrument is a LISTENER.

#(DCL) **Device Clear**, establishes a default condition as follows:

(@00)	Error status cleared.
(NO)	Notation code.
(DO)	Display code.
(I0)	Interrupt code.
(@1)	Error reporting enabled.
(W002)	Wait time.

#(DIA) **Dialogue**, establishes dialogue output format even if instrument has been set-up in non-dialogue format.

#(DPI) **Instrument identity**, identifies the instrument on the ring and returns the same data as the N5 command.

Command Blocking

All commands are echoed round the ring. However, if a command is preceded with the "%" character the command will be blocked if the instrument is set to end device.

Example: "%R1" <CR>

It is possible to establish any instrument as the **End Device** on the Daisy-chain by the SET-UP procedure. In this mode of operation, the instrument will:

(a) NOT allow command packets to pass through (i.e., packets of the form #....<CR>).

(b) NOT allow blocked packets to pass through (i.e., packets of the form %....<CR>).

(c) NOT allow flow control characters (X_{ON}/X_{OFF}) to pass through.

4.6.2 RS232 Output Code Format

In computer format all output commands are as described in the OUTPUT CODES section.

In the addressed mode the output is the same but will be enclosed in “{“ and “}”. This informs all the other instruments, on the daisy-chain, that the string originated from an instrument (not the control computer) and is not to be interpreted.

Status Condition

Status information is only available in addressed mode. The low level status condition of the instrument is reported to the control computer when addressed to TALK with the SECONDARY address 15 active.

The full status condition of the instrument is reported to the control computer when addressed to TALK with the SECONDARY address 16 active.

Dialogue Output Format

When dialogue output format is selected English text replaces the output code for each notation code.

Received Command = N0

Output is:

PRESSURE/SET-POINT/PANEL	=	<Value(7)><Units(6)>
MODE	=	REM/LOC
RANGE	=	1
ERROR	=	Error report if appropriate

Received Command = N1

Output is:

PRESSURE/SET-POINT /PANEL	=	<Value(7)><Units(6)>
ERROR	=	Error report if appropriate

Received Command = N2

Output is:

CONTROLLER ON/OFF
INTERRUPT ON/OFF/IN LIMIT/ERROR/EOC
ISOLATION ON/OFF

Received Command = N3

Output is:

OUT OF LIMIT/IN LIMIT
ERROR = Error report if appropriate

Received Command = N4

Output is:

ERROR REPORTING ON/OFF
MAX RATE/AUTO RATE/VAR RATE - ON
RATE = <Value(7)><Units(6)>"/s"
UNITS = Text for units used

Received Command = N5

Format:

"DPI520"<accuracy(3)><fullscale(12)>":"
<serial number(7)><terminator>

Example "DPI520 A1 70.0000 barg: 2222."

Received Command = N7

The status condition of the instrument is returned as:

<mode(3)><range(2)><scale(2)><value source(2)>
<controller status(2)><interrupt code(2)>
<notation code(2)><wait time(4)><terminator>

Example "REMR1S3D1C0I0N4W002"

Received Command = N8

The full status condition of the instrument is returned as:

<mode(3)><range(2)><scale(2)><value source(2)>
<controller status(2)><interrupt code(2)><notation code(2)>
<wait time(4)><error status(2)><terminator code(2)><rate(2)>
<variable rate(8)><units(7)><tare(2),<tare value(8)><terminator>

Example "REMR1S3D1C0I0N4W002@1E1J0V+000001.UPaT1B+000010."

Interrupt Data

Interrupt data is generated spontaneously by the instrument when preset conditions have been achieved. The source of interrupt is configured by the 'I' command.

"!"<address><CR>

where: <address> is the address of the instrument.

Example "!16"interrupt packet from instrument with address 16.

When the control computer receives an interrupt packet it should interrogate the instrument to find out the cause of the interrupt.

4.7 Operation Using IEEE 488

The IEEE 488 port allows up to 15 instruments to be controlled by a single computer over an IEEE-488 bus. Each instrument has a user configurable address. Commands are addressed over the bus. The instrument can transmit data (requested to TALK) or receive data (requested to LISTEN).

When the IEEE 488 bus is connected, the current instrument pressure reading or status information is obtained by addressing the instrument to "TALK".

The information sent back will depend on the last notation code sent to the instrument. N0 is the power-up default.

The instrument will exit local control and enter remote control after receiving the control code R1. The instrument will return to local control after receiving the control code R0 or M. The IEEE 488 bus command "GTL" will also return the instrument to local mode.

4.7.1 Serial Poll

The DPI 520 instrument will TALK in response to standard serial poll techniques. A single byte is sent whenever the instrument is programmed to TALK and the serial poll enable has been sent over the IEEE bus. The serial poll disable command discontinues the mode. The instrument activates the SRQ (service request) line of the IEEE 488 data bus when particular events occur. For example, if a programming error is made or if the pressure controller has reached a stable "in limit" condition. The trigger event is set by the 'I' command.

4.7.2 Standard IEEE commands

GTL **GO TO LOCAL** - Local control (manual) [default].

IFC **Interface clear** - Instrument not reset.

DCL **Device clear** - Reset instrument to default settings as follows:

Error status	@00
Notation code	N0
Display code	D0
Interrupt code	I0
Error reporting	Enabled
Wait time	W002

4.7.3 IEEE Bus Time-out

When the instrument receives the command to TALK, the transmit data is prepared before exchanging data with the control computer. The time-out value, the time that the control computer waits for the transmitted data, is selected and enabled in the control computer program.

It is recommended that the time-out value should be selected to greater than 50 msec to correspond with the beginning of read back character transmission. If the TALK command is preceded by other commands then there will be a greater delay before the read back character transmission commences. The extra delay is related to the execution of the preceding commands. For a multiple command string e.g. R1S0P200.0W20C1 allow a delay of approximately 1 second before requesting read back data. For much longer multiple command strings, the delay should be further increased.

4.7.4 RS232 Command Specific Commands

These commands are available only over addressed RS232.

Function	Command	Checksum	Action
Global	#(UNL)	55	Unlisten
	#(UNT)	63	Untalk
	#(IFC)	26	Interface Clear
	#(ADD)	17	Instrument Addresses
Addressed	#(DCL)	27	Device Clear
	#(DIA)	22	Dialogue Mode
	#(DPI)	37	Instrument FS/type/S/N
Talk/Listen	#T<Add>	19 + Add	Instrument Talk
	#L<Add>	11 + Add	Instrument Listen

Table 4.4 - RS232 Specific Command Checksums

NOTE: Added values are the ASCII checksum of the value, not the actual value. Table 4.5 gives the decimal values of the ASCII characters.

The checksums are calculated on a command by command basis. Therefore, for maximum data integrity, each command should be sent individually with its checksum appended. Blocks of commands should not be used because the cause of the checksum error cannot be detected.

4.7.5 DPI 500 Mode

The DPI 500 Mode enables the instrument to become compatible with existing DPI 500 instruments. When YES is selected, the decimal point is not sent in data from the instrument.

4.7.6 ASCII Values

Table 4.5, which provides details of the decimal values of the ASCII character set, is provided for reference purposes.

Decimal	ASCII	Decimal	ASCII
0	NUL	36	$
1	SOH (CTRL-A)	37	%
2	STX (CTRL-B)	38	&
3	ETX (CTRL-C)	39	‘ (Apostrophe)
4	EOT (CTRL-D)	40	(
5	ENG (CTRL-E)	41	)
6	ACK (CTRL-F)	42	*
7	BEL (CTRL-G)	43	+
8	BS (CTRL-H)	44	, (Comma)
9	HT (CTRL-I)	45	- (Minus)
10	LF (CTRL-J)	46	. (F.Stop)
11	VT (CTRL-K)	47	/
12	FF (CTRL-L)	48	0
13	CR (CTRL-M)	49	1
14	SO (CTRL-N)	50	2
15	SI (CTRL-0)	51	3
16	DLE (CTRL-P)	52	4
17	DC1 (CTRL-Q)	53	5
18	DC2 (CTRL-R)	54	6
19	DC3 (CTRL-S)	55	7
20	DC4 (CTRL-T)	56	8
21	NAK (CTRL-U)	57	9
22	SYN (CTRL-V)	58	:
23	ETC (CTRL-W)	59	;
24	CAN (CTRL-X)	60	<
25	EM (CTRL-Y)	61	=
26	SUB (CTRL-Z)	62	>
27	ESC (CTRL-[)	63	?
28	FS (CTRL-\)	64	@
29	GS (CTRL-])		
30	RS (CTRL-^)		
31	US (CTRL-_)		
32	(SPACE)		
33	!		
34	“		
35	# (or)		

Table 4.5 - ASCII Values

Decimal	ASCII	Decimal	ASCII
65	A	101	e
66	B	102	f
67	C	103	g
68	D	104	h
69	E	105	i
70	F	106	j
71	G	107	k
72	H	108	l
73	I	109	m
74	J	110	n
75	K	111	o
76	L	112	p
77	M	113	q
78	N	114	r
79	O	115	s
80	P	116	t
81	Q	117	u
82	R	118	v
83	S	119	w
84	T	120	x
85	U	121	y
86	V	122	z
87	W	123	{
88	X	124	|
89	Y	125	}
90	Z	126	~
91	[	127	DEL
92	\ (or)		
93	]		
94	^		
95	_ (U/Line)		
96	` (back quote)		
97	a		
98	b		
99	c		
100	d		

Table 4.5 (cont.) ASCII Values

5 CALIBRATION

The instrument is supplied by the manufacturer, complete with calibration certificate(s). The re-calibration interval will depend on the total measurement uncertainty which is acceptable for a particular application. In order that the instrument remains within the quoted accuracy, it is suggested that it's calibration be checked at 90 day intervals.

The DPI 520 instrument is a very precise controller and measuring instrument and the test equipment and conditions of test must be suitable for the type of work. The use of a Class A compensated dead-weight tester is essential. The tests should be carried out in a controlled environment by a competent, trained person.

If, when the accuracy of the instrument is checked, it is found to be outside the specification, calibration adjustment can be undertaken to compensate errors.

The manufacturer offers a comprehensive and, if required, NAMAS accredited calibration service.

5.1 Calibration Check

At the chosen interval, the instrument readings should be compared with a known standard. Any deviations between the instrument and the standard should be noted, taking due account of the traceability (accuracy to a National Standard). If these deviations exceed the published tolerance, or any other suitable chosen performance standard, then the user may wish to carry out a calibration adjustment. The following sections in this chapter explain the method of calibration adjustment.

The recommended procedure is to check at increasing and then decreasing intervals of 0, 20, 40, 60, 80 and 100% of full scale.

5.2 Calibration Adjustment

Before carrying out any calibration adjustments, the results of the calibration check should be studied to determine the nature of the deviations to be adjusted. If only offset (zero) and gain (full scale) are exhibited and the recorded measurements are otherwise essentially linear then only a **ZERO** and **FULL SCALE** adjustment is required.

If there is non-linearity, with or without offset and gain errors, then non-linearity compensation adjustment is necessary.

Temperature performance drift is most unlikely. In the unlikely event that this type of error is found, it is most probably an indication of a damaged or failing transducer. Under these circumstances, it is recommended that the instrument be returned to a qualified service agent.

The use of a dead-weight tester, having measured masses and correcting for temperature and gravity, is considered mandatory for this level of calibration. The work should be conducted in a controlled environment, with adequate stabilisation time before and during adjustment.

5.2.1 General Procedures

The following general hints are provided as a guide to calibration procedures.

DO

Use high quality **Repeatable and Linear** pressure sources and allow adequate stabilisation time before calibration (minimum 1 hour).

Conduct the calibration in a temperature and preferably, humidity controlled environment. Recommended temperature is **21°C, ±2°C**.

Use dead-weight testers carefully and away from draughts.

DO NOT

Conduct non-linearity compensation unless a calibration check shows excessive non-linearity.

Conduct temperature compensation unless certain of the reason why the compensation has changed.

NOTE: Temperature compensation is only available on the high accuracy DPI 520 models (options A1 and A2).

5.3 Using the Calibration Menu

The calibration routines are enabled by a switch located on the rear panel of the instrument. To select the **Calibration** mode, remove the sticker located on the rear panel of the instrument and set the **Cal** switch to the **1** position - to the right, looking at the rear panel of the instrument (e.g.)

This action switches the instrument into the **Cal** mode and if a PIN number has been set-up (refer to Section 3.9.2) the display will be as follows (e.g.),

Calibration Mode
Enter P.I.N.

Enter the appropriate PIN number, press ← and the calibration menu will be displayed as follows. This display will appear immediately that **Cal** is selected if no PIN number has been set-up.

Select Mode:
Cal Test

5.3.1 Test

This option of the calibration menu provides an indication of the instrument's status. This facility is primarily an engineering function. The temperature reading (representing the temperature inside the transducer), is only valid if the instrument is one of the high accuracy options (options A1 or A2), and valid calibration data exists. The DVM reading gives an indication of the number of counts, representing the current pressure, in the DVM's analogue to digital converter. For full scale applied pressure this nominally represents 2.5V.

20.14 Temp Deg C
2.5000 DVM

5.3.2 Calibration (Cal)

Selection of this option of the calibration menu immediately initialises a calibration routine for the digital to analogue converters which is displayed as follows (e.g.),

2.565 Cal DAC
Please Wait ....

After a few seconds, the **Cal** menu will be displayed (e.g.)

2 Point Linearity Quit

These options are used to select either a two point calibration routine or a or full linearity calibration. The high accuracy options of the instrument provide an additional temperature compensation facility (TC). For the high accuracy options only, the following calibration menu will be displayed.

2 Point Linearity TC

Temperature compensation by the user is **NOT** recommended, hence no temperature compensation procedures are described in this manual.

- **Zero and Full Scale Adjustment (2 Point Cal)**

  Selection of the **2 Point Cal** option of the **Cal Menu** enters a routine which requires the application of a zero pressure and a full scale pressure. Details of full scale and zero adjustment are given in Section 5.5.

- **Non - linearity Adjustment (Linrty)**

  Selection of the **Linrty** option of the **Cal Menu** enters a routine which requires the entry of at least three calibration pressures. The method of carrying out non-linearity correction is described in Section 5.6.

5.4 Checking Linearity Calibration

TURN OFF THE SOURCE PRESSURE AND VENT THE SYSTEM PRESSURE BEFORE DISCONNECTING OR CONNECTING ANY PRESSURE LINES. PROCEED WITH CARE.

To check an instrument's calibration, proceed as follows.

- Isolate and disconnect the pressure supply source.
- Vent the pressure on the system side of the instrument and disconnect the pressure connection to the outlet port.
- Connect the outlet port of a pressure standard to the **OUTLET** port of the instrument under test.
- Wait one hour to allow the instrument to stabilise.
- Adjust the pressure standard to the most negative pressure value within the range of the instrument. For positive reading instruments, this value will be zero. Allow the applied pressure to stabilise.
- Record the output pressure of the pressure standard and the corresponding instrument reading (shown on the display).
- Repeat the application of test pressures for a minimum of six increasing pressures, zero, 20%, 40%, 60%, 80% and 100% F.S., recording the corresponding instrument readings for each test pressure.
- Commencing at full scale, repeat the application of test pressures in decreasing steps down to zero (or -ve value if applicable). **DO NOT VENT TO ATMOSPHERE BETWEEN POINTS.**
- Calculate the percentage error of the instrument's pressure reading against the applied test pressures.
- Check that the calculated values are within the accuracy limits stated in Section 1.

5.5 Full Scale and Zero Adjustment

TURN OFF THE SOURCE PRESSURE AND VENT THE SYSTEM PRESSURE BEFORE DISCONNECTING OR CONNECTING ANY PRESSURE LINES. PROCEED WITH CARE.

To perform a zero and full scale adjustment, proceed as follows.

- Isolate and disconnect the pressure supply source.
- Vent the pressure on the system side of the instrument and disconnect the pressure connection to the outlet port.
- Connect the outlet port of a pressure standard to the instrument's outlet port.
- Set the **Cal** switch located on the rear panel to the **1** position.
- Enter the calibration menu as outlined in Section 5.3 and 5.3.2. This will open the isolation valve.
- Wait one hour to allow the instrument to stabilise.
- Select **2 point** from the calibration menu the following prompts will be displayed (e.g.)

Zero pressure
Enter when stable ←

Set the pressure standard to the required zero pressure allow time for the pressure reading to stabilise. Enter the zero pressure reading on the numeric keypad and press ← (use 35 mbar or 1% F.S. for absolute instruments and -ve F.S. for differential instruments). When satisfied that the pressure has stabilised, press ←.

NOTE: If a negative calibrated instrument, the pressure standard should be connected to the reference port for the zero reading.

For highest possible accuracy, ensure as wide a span as possible between the zero and F.S. calibration points.

- After entry of the zero pressure, a prompt is given for the full scale pressure (e.g.)

F.S. pressure
Enter when stable ←

Set the pressure standard to the required full scale pressure and allow time for the pressure reading to stabilise. Enter the full scale pressure reading on the numeric keypad and press ←. When satisfied that the pressure has stabilised, press ←.

- Following entry of the second point the **2 point** calibration is complete and the instrument returns to the calibration menu.

- Repeat the calibration check to see that the correction has been effective.

NOTE: Follow display prompts to exit calibration mode or the error message "EEPROM Failure" will be displayed.

5.6 Non-Linearity Adjustment

Before any linearity compensation procedures are carried out, perform a **2 Point** calibration followed by a linearity check to determine whether or not full linearity compensation should be carried out. If the linearity calibration check shows linearity errors, perform a linearity compensation as follows.

TURN OFF THE SOURCE PRESSURE AND VENT THE SYSTEM PRESSURE BEFORE DISCONNECTING OR CONNECTING ANY PRESSURE LINES. PROCEED WITH CARE.

- Isolate and disconnect the pressure supply source.

- Vent the pressure on the system side of the instrument and disconnect the pressure connection to the outlet port.

- Connect the outlet port of a pressure standard to the instrument's outlet port.

- Set the **Cal** switch located on the rear panel to the **1** position.

- Wait one hour to allow the instrument to stabilise.

- Enter the calibration menu as outlined in Section 5.3 and 5.3.2.

- Select **Linrty** from the calibration menu and the following prompts will be displayed (e.g.)

  Pressure Pt 1
  Enter when stable ←

  Set the pressure standard to the required lowest (zero) pressure allow time for the pressure reading to stabilise. Enter the zero pressure reading on the numeric keypad (35 mbar or 1% F.S. for absolute instruments -ve F.S. for differential instruments), and press ←. When satisfied that the pressure has stabilised, press ←.

  NOTE: If a negative calibrated instrument, the pressure standard should be connected to the reference port for the zero reading.

- A prompt will now be given for a second point as follows (e.g.),

  Another point ?
  Yes No Abort

- Select **Yes** and enter the next (and subsequent) test pressures as detailed above. A minimum of three points must be entered for all types of instrument. Standard instruments will accept a maximum of 5 points, true differential and Option B, negative Cal gauge instruments a maximum of 10 points. High accuracy option instruments, options A1 and A2 accept a maximum a maximum of 24 points. Recommended test pressures for the instruments are as follows. All figures quoted as a percentage of full scale reading.

Standard	0, 50%, 100%
Option A1	0, 14%, 28%, 56%, 100%
Option A1 - Neg Cal	0, ±14%, ±28%, ±56%, ±100%
Option A2	0, 9%, 18%, 27%, 42%, 58%, 77%, 100%
Option A2 - Neg Cal	0, ±9%, ±18%, ±27%, ±42%, ±58%, ±77%, ±100%
Option B - Neg Cal	0, ±14%, ±28%, ±56%, ±100%

- After application of the last required pressure, select **No** from the **Another point?** prompt. If the last point available has been used the linearity calibration routine terminates automatically.

  NOTE: Follow display prompts to exit calibration mode or the error message "EEPROM Failure" will be displayed.

- After application of the last required pressure, select **No** from the **Another point?** prompt. If the last point available has been used the linearity calibration routine terminates automatically.

  NOTE: Follow display prompts to exit calibration mode or the error message "EEPROM Failure" will be displayed.

6 MAINTENANCE

There are no user serviceable parts on the DPI 520 instrument other than the Source, Vent and Output manifold filters and the a.c. power supply fuses.

6.1 Safety Instructions

- Observe the general safety procedures detailed at the beginning of this User Manual.
- This instrument must only be serviced by a Druck approved service organisation or by a competent person. Section 6.4 details a list of Druck subsidiaries worldwide.
- "Continuing Electrical Safety Assessment (Electricity at Work Regulations)". A periodical inspection of the instrument to determine the continuing electrical safety may be carried out at the user's discretion. If the user decides that practical testing is required to determine the continuing electrical safety then testing to prove the Earth Continuity (limited to 25 Amp test current for 5 seconds) and Insulation Resistance ($500V_{dc}$) may be carried out .
- Do not use replacement parts other than those supplied by the manufacturer or manufacturer's agent.

6.2 Fuse Replacement

If, when an a.c. mains power supply is connected to the instrument, the instrument fails to operate, replace the power supply fuses as follows (refer to Figure 6.1).

- Isolate the external power supply and remove the IEC mains connector (1).

  NOTE: If rear access to the rack is restricted, it may be necessary to partially or completely withdraw the unit. If the unit has to be withdrawn, all pressure supply inlet and outlet lines must first be isolated.

- Remove the fuse carrier (3) from the power supply inlet socket (1) and remove both fuse cartridges. Replace both fuse cartridges (4).

  NOTE: It is essential that the correct type of fuse is fitted to the instrument. Before fitting the replacement fuses into the fuse carrier, check that they are both of the same type and rating (20mm, Type T2A, rating 250V, 2A). Also check each fuse for continuity.

- Replace the fuse carrier assembly (3), complete with fuses, into the power supply inlet socket (2).

- Replace the IEC mains connector (1). If the unit was withdrawn from the rack before replacing, check that the pressure connections are still tight. Do not over tighten.

- Switch on the power supply. The display should now operate.

- If the fuse(s) blow immediately on switch on, contact the manufacturer or Service Agent. A list of Druck Service Agents is given at the end of this section.

DO NOT ATTEMPT ANY FURTHER SERVICING PROCEDURES

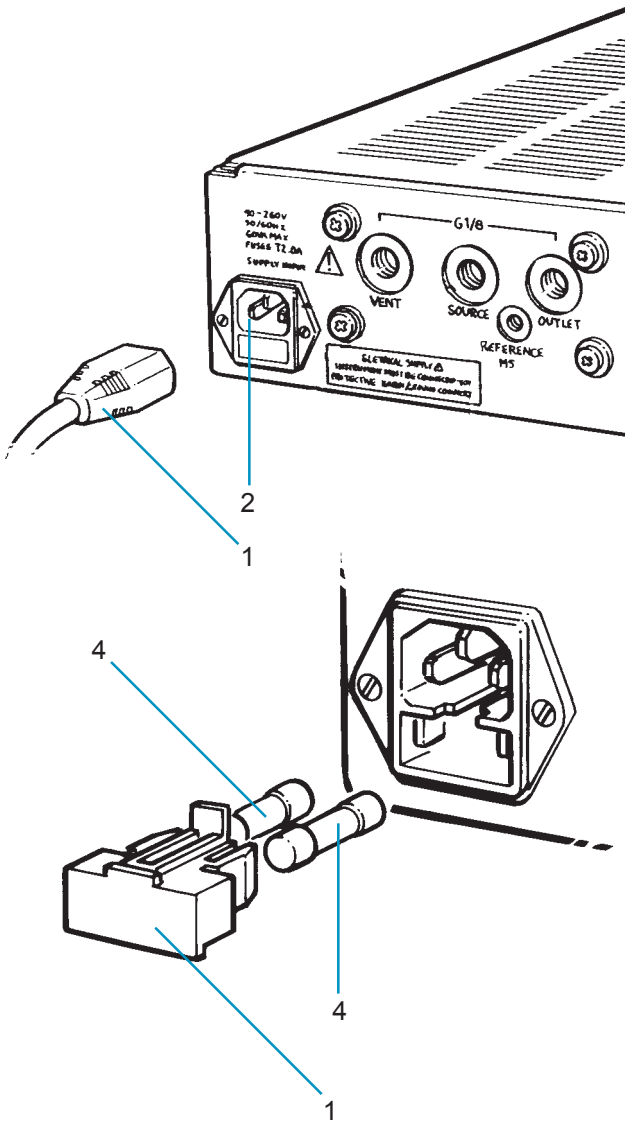


Figure 6.1 Power Supply Fuse Replacement

6.3 Replace Vent, Source and Outlet Manifold Filters

To replace the manifold filters, proceed as follows.

- Ensure that the supply pressure and system pressure are isolated from the instrument.
- Isolate the power supply and remove the IEC power supply connector.
- If removing the instrument from the rack to gain access to the rear panel, the communications interface cables will also need to be removed.
- Remove the pressure connections from each of the ports and remove the vent silencer from the vent port.
- Using a screwdriver, carefully unscrew and remove each filter plug and filter from the bores of the connection ports.

CAUTION: Ensure that the screwdriver blade is narrow enough to clear the bore threads.

- Insert a new filter element into the recess on the top of the filter plug and carefully screw each filter plug into the bore of the port.

  Check that the filter elements are correctly seated before tightening. The elements can be examined through the centre hole of the filter plugs.

CAUTION: Do not over-tighten.

- Replace pressure connections, communications interface connections, refit power supply cable and refit the instrument to the rack.
- Switch on power supply and pressure source and test installation.

6.4 Cleaning

Clean the front panel with a damp cloth and mild detergent.

DO NOT USE SOLVENTS FOR CLEANING PURPOSES.

6.5 Fault Finding

In the event of an instrument malfunction, it can be returned to the Druck Service Department or Druck Agent for repair. A service charge price list is available which details the charges associated with various service functions.

6.5.1 Error Codes

When the instrument detects an error, a code number is displayed the error and possible remedy for each code are listed in Table 6.1.

Code	Error	Cause/remedy
“Err001”	Over-pressure	Reduce source pressure
“Err002”	Lock mode on	Remove lock - Sect 3.9.2
“Err003”	Pressure too high for range	Reduce source pressure. Vent system pressure.
“Err004”	Set-point out of limits	Refer to set-point - Sect.4.5.9
“Err005”	Manual zero is disabled	Refer to Section 3.9.4
“Err006”	Zero reading in progress	Wait for zeroing process to end
“Err007”	Zero error too large	Zero offset > 5% of limit. Ensure system is venting correctly.
“Err008”	Illegal PIN entry	Incorrect PIN entered.
“Err009”	Access denied	Three consecutive incorrect PIN entries made.
“Err010”	Wait zeroing	Zero in progress. Set-point, rate and controller commands ignored until zero operation completed.
“Err011”	Set-point too high for range	Reduce set-point value.
“Err012”	Remote enable	Not in remote. Issue R1 command
“Err013”	Invalid entry	Value entered is outside operational limits. Revise value.
“Err014”	Using alter initialises set-up	Before proceeding, make sure that a change to set-up is required.
“Err015”	Not applicable	
“Err016”	Vent time too long	Zero function fails to operate as venting takes too long.
“Err017”	Valve overtemperature	Apply or release valve or both overheating. Allow to cool. Controller parameters may require adjustment (See Section 3.9.2 - controller set-up)

Table 6.1 - Error Codes

6.5.2 Controller Fault

Symptoms - *No outlet pressure when setpoint entered and controller switched on*.

Solution

- Check that the communications link is working.
- Check that source pressure is 110% of the F.S. pressure
- Check supply filter and pipe for blockages.
- Possible apply, release or isolation valve fault.

Symptom - *Controller instability*
- *Excessive acoustic noise from instrument*

Solution

- Check instrument for a pneumatic leak. Run pneumatic self test (refer to Section 3.9.2).
- Check that the source pressure is within the operational limits (refer to Section 1).
- Check output system for pneumatic leak.
- Set-up controller parameters, adjusting the stability value as detailed in Section 3.9.2.

6.6 Approved Service Agents

The following are approved agents for Druck Instruments.

FRANCE

Druck S.A.
19 Rue Maurice Pellerin,
92600 Asniéres,
France.
Tel: (331) 47 93 00 48
Fax: (331) 41 32 34 64

GERMANY

Druck Messtechnik GmbH,
Lessingstrasse 12,
61231 Bad Nauheim,
Germany.
Tel: (06032) 35028/29/20
Fax: (06032) 71123

HOLLAND

Druck Nederland B.V.,
Postbus 232,
Zuideinde 37,
2991 LJ Barendrecht,
The Nederlands.
Tel: (01806) 11555
Fax: (01806) 18131

ITALY

Druck Italia Srl.,
Via Capecelatro 11,
20148 Milano,
Italy.
Tel: (02) 48707166
Fax: (02) 48705568

JAPAN

Druck Japan KK,
Medie Corp Building 8,
2-4-14 Kichijyoji-Honcho,
Musashino,
Tokyo 180,
Japan.
Tel: (81) 422 20 7123
Fax: (81) 422 20 7155

UK

Druck Limited,
Fir Tree Lane,
Groby,
Leicester LE6 0FH,
England.
Tel: (0116) 231 7100
Fax: (0116) 231 7103

USA

Druck Incorporated,
4 Dunham Drive,
New Fairfield,
Connecticut 06812,
U.S.A.

Tel: (203) 746 0400
Fax: (203) 746 2494